Beyond boundaries
from extended to bio-semiotic minds

De Jesus, Paulo

Awarding institution:
King's College London

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From Extended To Bio-Semiotic Minds.

Paulo De Jesus

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Department of Philosophy,

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Abstract

In recent years researchers from a variety of cognitive science disciplines have been challenging some of the core assumptions of the dominant cognitivist theoretical framework, including the abstract disembodied functionalism of information-processing models. In its place an alternative situated cognition paradigm has gradually emerged, one which sees cognition as deeply embodied-embedded and no longer the sole product of information-processing brains.

The extended mind hypothesis (EMH), proposed by Andy Clark and David Chalmers (1998) in the now famous "The Extend Mind" paper, offers one particular approach to this new conception of cognition. In it the authors argue that, cognitive and mental processes are not exclusively located inside the cranium of individuals, but rather, are at times unbounded and constituted by bodily and environmental resources which agents routinely deal with. However, exactly *what* cognition is, remains unaddressed. This dissertation takes this question as its point of departure.

Thus EMH is read as being grounded upon two core motivations. The first, more self-evident motivation, relates to the extended nature of cognitive boundaries. The second relates to the self-proclaimed challenge it makes on traditional cognitivists accounts of cognition.

After an appraisal, it is concluded that the EMH remains deeply committed to cognitivism and as such, should be considered as part of traditional cognitive science rather than as an opposition to it. Nonetheless, inspired by its two central motivations, it is proposed that these could be saved, if a location-neutral, non-cognitivist, non species-specific "mark of the cognitive" can be provided. The second half of this dissertation is then dedicated towards this goal.

Drawing primarily from the work of Jakob von Uexküll and the field of biosemiotics, I propose a conception of cognition as rooted in organismic life and as emergent from a biological autonomous agent's capacity for natural semiosis. It is argued that cognition

is a natural biological process of goal-directed organism-environment systems striving for self-maintenance through sign-mediated adaptive functional cycles. The most fundamental cognitive capacity a system can have, is the ability to read and interpret, *meaningful natural signs.*

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Introduction

1 Not in the Head

We routinely use external devices, props and tools to aid and support most of our daily activities. We make notes on notebooks, use phones to save phone numbers, blackboard and chalk to work out complex equations and much more besides. But, how are we to understand these particular activities? More specifically, how are we to think about the *cognitive processes* underlying these activities. Given the overtly distributed nature of these activities, a closely related question has recently resurfaced in cognitive science and philosophy of mind, *where* is the boundary between agent and environment to be drawn?

Considerations regarding the bounds of the cognitive, received virtually no attention during the first few decades of cognitive science, where cognition was theorised exclusively in terms of "internal" computational processes implemented on neural machinery. Moreover, these early conceptions of cognition also paid relatively little attention to either the agent's body or his interactions with the broader environment. However, partly inspired by the emergence of what in this work I call situated cognition (SC), the question has once again resurfaced and become a serious matter of debate.

Clark and Chalmers (1998) set the ball rolling by proposing the so-called "extended mind hypothesis" (EMH). They argued that cognition was not exclusively located inside the head, but was at times *constituted* by bodily and environmental resources. For over a decade now, theorists inspired by the EMH (Clark, 1997, 2003, 2008; Clark & Chalmers, 1998; Hurley, 1998; Menary, 2007, 2010; Rowlands, 1999, 2010; Sutton 2010; Wheeler, 2005; 2010; Wilson 2004; 2010) have carved out a niche in the philosophy of mind/cognition, by defending a position which goes very much against what had traditionally been considered to be the true bounds of cognition and cognition generally. Accordingly, there are occasions when cognition is said to "extend" into the nonbiological environment.

However, what remains ill addressed in this debate is; what exactly is cognition so that it could be said to be extended? This dissertation attempts to address this question with one eye on the EMH debate.

Thus, against this theoretical backdrop, the EMH is first understood as an *approach to SC*. In the spirit of its revolutionary fervour, I read its central proposal as being grounded upon *two* core motivations. The first, more self-evident motivation, relates to the extended nature of cognitive boundaries. The second motivation, directly inspired by work in SC, relates to how it attempts to *challenge traditional accounts of cognition*.

At this point I need to introduce a caveat. This dissertation is not *exclusively* about the EMH, though it draws direct inspiration from one of its core motivations. Here the EMH (or certain core aspects of it) is used more as a vehicle against which an alternative conception of cognition can be presented. For these reasons this dissertation does not directly engage with all the trenchant warfare amongst critics and advocates of the EMH. Indeed, as will soon become apparent, these issues cannot be resolved only dissolved. I therefore sidestep some EMH-specific issues by arguing that the debate about boundaries, once properly understood, simply dissolve away.

With this understanding of the proposal and caveat in hand, this dissertation then attempts to defend and further elaborate on, the second core motivation of the EMH to see if it can shed any light on the first. Approaching the issue in this manner demands a shift of focus away from myopic concern over boundaries, towards considerations regarding the *underlying nature of cognition itself*. What is it that makes systems *cognitive* in the first place. We therefore first need an account of *what* cognition is before we can argue about *where* it is, we need a "mark of the cognitive" (MoC).

A guiding premise of this work, argued explicitly in Chapters 3,5,6, is that the boundaries of living systems, are invariably fluid, dynamic and non-stable. As a consequence I argue that, a central problem for the EMH debate is that, whether cognition extends or not, will always depend on the interests, motivations and goals of whoever is making the enquiring. Appreciating these points, will go some way in showing that there is little benefit arguing about boundaries as such. Nonetheless, the particular understanding of cognition, the MoC one endorses, will inevitably inform how one conceives of these boundaries.

I begin by introducing two distinct theoretical approach to how cognition is currently understood within cognitive science. In the second chapter we present the central tenets of the EMH and appraise it in relation to both SC and cognitivism. I argue that the EMH is, what I call, a Janus-faced proposal. This conclusion is inspired by the fact that the EMH is motivated by insights from SC, but clings to cognitivism. From this analysis, I go on to align the EMH within traditional cognitivism and downplay its self-proclaimed radicalness and revolutionary ambitions. In the following chapter, I present arguments against the idea of static intrinsic boundaries and go on to motivates why the EMH, and cognitive science more generally, needs a MoC.

The following three chapters sketches out an alternative conception of minimal cognition designed to avoid the central tenets of cognitivism. Drawing primarily from the work of Uexküll and biosemiotics, I propose a conception of cognition as rooted in organismic life and emergent from natural semiosis. Meaning and signification is understood in terms of triadic sign-mediated processes, and is taken to be the fundamental feature of cognition. Cognition is conceived as a natural biological process of goal-directed agents striving for self-maintenance, through sign-mediated adaptive functional cycles. It is concluded that this understanding of cognition is *relational*, and as such, not spatially located.

Chapter One
What is Cognition

Introduction

Before discussing the EMH, some theoretical stage setting is required, this is the aim of this chapter. I provide an overview of the two dominant theoretical approaches to the study of cognition and unearth some core theoretical commitments.

1 Cognitive Science

1.1 - What is Cognition?

What is cognition? Although cognition is the central concept in the cognitive sciences, there is currently no universally accepted answer to this question. Indeed, explicit conceptual interpretations are usually the subject of controversy (e.g. Brooks 1999; Dennett 1996; Clark 1997). Cognitive scientists tend to rely on intuition and common sense to identify certain tasks, abilities, capacities etc, *as cognitive* and then propose mechanisms responsible for the performance of these tasks. As Rowlands (2003. p, 158) claims; "cognitive tasks are those tasks *we say* are cognitive. Cognitive processes, then, consist in those information-processing operations that are essential to the solution of cognitive tasks”.[1]

A distinction between cognitive *behaviours* and cognitive *processes* might be helpful. Cognitive behaviours are those observable behavioural patterns manifested by observed systems. Something is then ascribed cognitive status if it belongs to the class of cognitive behaviours. This class is then picked out by identifying paradigmatic instances i.e., planing, reasoning etc. Cognitive processes on the other hand, relate to the *implementation* of cognitive behaviours. That is, cognitive processes are those processes or *mechanisms*, grounding cognitive behaviours.

In so doing we end up with a list of prototypical behaviours which are *ascribed* cognitive status and which make up the cognitive domain. This list includes a host of

[1] Throughout this work I will refer to this standard manner of demarcating cognition as *ascriptional.*

diverse phenomena, typically involving but not restricted to, believing, knowing, thinking, reasoning, planing, memory and language. This amounts to taking up, what Dennett (1987) calls, an *intentional stance.* Which involves treating a systems as a *rational agent* and working out its behaviour in terms of its *beliefs and desires.*

There is also strong, though perhaps tacit, consensus that cognition is best exemplified by *human beings.* Typically human (adult) cognition is the *uncontested benchmark* against which the abilities of other organisms are measured by. Hence a tendency to focus on a small number of highly evolved and complex *human-specific* cognitive skills. Abilities which are then generalised to be the most plausible and fruitful guide to understanding cognitive phenomena. Thus, for most cognitive scientists, human cognition provides the only unquestionable and uncontroversial example of *what* cognition is and so serves as the *starting point* into the enquiry. I follow Lyons (2006) in referring to this species-centric approach to cognition as *anthropogenic.*

From this perspective, cognition is tantamount to characteristically human-like capabilities such as reasoning, problem-solving and requires beliefs/desires. These processes have to be present to a significant degree before one can speak of a bona fide cognitive system (Gould & Gould 1998). Internal, representation-handling processes (see below) are considered to be the source of these particular thinking skills, and it is a matter of painstaking research to establish whether, and if at all, which creatures also exhibit these capabilities.

We might note here already that this seems to imply a radical break from other living organism. Although some complex animals such as primates and birds, can qualify as genuine cases of cognition or represent the borderline cases, it nonetheless depends to what extent these *exhibit human-like qualities*. While, less complex organisms, such as invertebrates and single-celled organisms which are deemed incapable of such complex capacities, are not considered cognitively interesting. The behaviour of these types of organisms are usually regarded as the product of species-specific instincts or hard-wired reflexes which have little to do with cognition or agency (Godfrey-Smith 2002; Keijzer 2001; Lyons 2006). True cognition is a scarce commodity here.

One further important consequence of adopting an unrestricted anthropogenic perspective, is that by exclusively focusing on highly evolved cognition, it *devalues* and *marginalises* other "less sophisticated" aspects of cognition. In so doing it systematically encourages the assumption that, not only is there an *intrinsic* fact-of-the-matter distinction between "basic cognition" and "cognition proper", but also, that one can understand cognition *without* having to pay much attention to these so-called "basic forms" of cognition (Keijzer 2001). We revisit these issues in Chapters 4&6.[2]

1.2 - Cognition in the Age of Computers

Cognitive scientists are interested in explaining *how* cognitive *processes* work. Indeed, cognitive science emerged as an interdisciplinary attempt to systematically answer this question. Bechtel and colleagues point out that the three main objectives of cognitive science is to provide an explanation of *what* cognition is, what it *does* and *how* it works (Bechtel et al. 1998). To understand the answers it provides, we need to take a closer look at some of its underlying theoretical foundations.

One of the defining characteristics of cognitive science, is that it proposes physical *mechanisms* for cognitive processes. It offers a particular way of conceptualising and explaining the *machinery* responsible for cognition. It does so by *formalising* and *mechanising* cognition and offering a *naturalistic causal link* between mentality and behaviour (Crane 1995). By introducing mechanisms, cognitive scientists unite the cognitive domain, with observable behaviour. It is at this point that the idea of mind/brain as *information-processing device* enters the picture (Boden 2006; Bermúdez 2010). Here perceptions serve as input, action as output, and all "the things in between are the information processing" (Cisek 1999). This particular conceptualisation of cognition, provides the answer to the *what* and as a consequence, the *where* of cognitive processes.

The central idea behind the so-called "computer metaphor" is that, mind, stands in relation to the brain, as software to hardware in computers. Cognition *just is* a type of

[2] In this work I follow standard practice and refer to lower level cognition as "basic cognition". However, the assumptions on which this distinction is premised are not accepted and outrightly reject. My main issue is that the distinction seems to merely contribute to the *neglect* of other forms of cognition (see Chapters 4&6).

computation, understood as information-processing via the manipulation of symbolic (or subsymbolic in connectionism) representations. Consequently;

> It became natural to think of human beings as information processing systems that received input from the environment (perception), process that information (thinking), and act upon the decision reached (behavior) (...) anything humans do could be viewed in information processing terms: reading, remembering facts, recognizing objects, drawing logical conclusions, solving difficult problems, playing chess...(Pfeifer & Scheier 1999, p. 37).

It is this understanding of cognition which is now known as *cognitivism* (Wallace 2007). Ultimately, humans cognise by virtue of processing information in the form of inner symbolic representations, which represent an external mind-independent environment. These representational states are then manipulated using 'rules' (algorithms) resulting in relevant action. Cognition is segmented into a secession of stages, at each stage particular computational operations are performed on incoming information (Fodor 1975; Pylyshyn 1984).

These ideas are famously captured in the Physical-Symbol System Hypothesis, which holds that a system of this nature, implemented in a physical medium, "has the necessary and sufficient means for general intelligent action" (Newell & Simon 1976). By "necessary" it was meant that any system which does not have these properties *cannot* be intelligent, and by "sufficient", it was implied that a system having these characteristics, had the potential to be intelligent

This is a prime example of higher cognitive functions being mechanistically explained in terms of formal rule-based processing of internal symbols. These symbols in turn are generally assumed to be inside the brain, analogous to a computer program (the software) being inside a computer (the hardware), whilst at the same time, body and environment are reduced to simple input/output devices.

1.3 - Information Sheds its Materiality

Implicit in cognitivism is a tacit endorsement of an inside/outside dichotomy inherited from Cartesian Dualism. A dichotomy maintained by identifying an "inner" domain populated by various mental states, such as beliefs, desires, thoughts, and other experiences, separate from an "outer" domain of raw physical goings-on available to sensation, the perceptual information that human sensory systems “take in".

An extreme example, but nonetheless representative of the assumption, is found in Fodor's (1980) “methodological solipsism”, which is explicitly premised on the inside/outside dichotomy, and proceeds by “methodologically” assuming the fundamental soundness of the boundary conditions supporting this division. For Fodor, only by treating the mind as a more or less *isolated* and *self-contained bounded unit*, can we understand how it works. Similarly, traditional cognitive science encourage us to think of an agent's cognitive behaviour as enabled by an isolated system that extracts information from the environment and encodes it so as to be used within an inner analytic domain.

This dichotomy, conserved by cognitivism in the guise of the distinction between hardware and software, is theoretically grounded on metaphysical *functionalism.* If mind is software, then it must be just like a program, which can be implemented on any kind of machine (Hayles 1999). Mentality is therefore necessarily *multiple realisable,* meaning it can be implemented in multiple substrates. Mind as software can run on any machine or hardware, what is crucial is the abstract *causal relations* between inputs, inner states and outputs, not what realises it (Pfeifer and Scheier 1999, p, 43).

Consequently cognitivism became solely concerned with the software side of the distinction. It focused on abstract disembodied *information* at the expense of embodied *materiality*. As Neisser (1967) claims, cognitive scientists; “wants to understand the *program, not the hardware*”. The ultimate conclusion reached was that if the mind is an information-processor, then computers not only can help us *model* its activities, but also allow us to *create* artificial minds (Boden 2006).

In sum, cognitivism demarcates the cognitive domain by ascription, takes human cognition as the benchmark for cognition in general and conceptualise it as rule-based symbol-involving information-processing. The brain is the seat of intelligence, cognition is centralised and anything outside of it, is considered a mere source of input.

1.4 - The "Traditional View" in Three Theses

From our discussion above we can extract three separate, but interconnected theses, regarding the *nature of cognition*, as commonly demarcated by *ascription*.

Firstly, cognition is the product of rational self-contained bounded units endowed with causally efficacious mental states, which perceives, plans and finally acts on the environment on the bases of these states. Agent and environment are understood to be two *ontological distinct categories* (inner/outer) connected by these mental states. It emphasises the existence of a world qualitatively differentiated from the observing agent and preceding any cognitive act. This we can call the *individualist thesis*.

Secondly, by building on the first thesis, cognitive agents are understood as *computational information-processors,* composed of modules which use internal symbolic (sub-symbolic in connectionism) representations, process these according to specified rules and produce relevant outputs. Cognition is a process whereby information is "picked-up" from a mind-independent world, represented internally through symbolic data-structures, reasoned with and used for planing and acting in the world, knowledge is grounded in a "storehouse" of mental representations, which can be reliably called upon when required. This we can call the *computationalist thesis.*

Finally, more implicit and less explored than the other two but nonetheless ubiquitous, is that cognition considered as essentially brain-bound is primarily, if not exclusively, a *human affair.* That is, human cognition forms the *benchmark* for what cognition in general is. This is a methodological assumption which takes *human psychology* as its starting point. We can call this the *anthropogenic thesis*.

These three theses, taken together, form the theoretical core of *traditional* cognitive science. I follow standard convention in referring to this approach as *cognitivism*. For the rest of this dissertation I will work under the assumption that cognitivists, to a lesser or greater extent, are committed to *all three* theses, and as such, only by rejecting all three, can cognitivism be overcome.

2 Situated Cognition

2.1 - Cognition in the Age of Robots

Amidst all this high-level abstraction, it did not go completely unnoticed that cognitive agents are *situated, physically embodied* and in *continuous dynamic interaction* with their environment. Indeed, it was an appreciation for these observations which inspired the development of the alternative research program of *situated cognition* (SC).

More specifically, the SC movement emerged *within* cognitive science, as a direct challenge to some of the tenets of cognitivism. The central focus of this research involves studying cognitive activity by examining the ways in which *embodied* agents relate to and *interact* with their environments. It changes the emphasis of searching for the cognitive inside the skull to exploring the dynamic relations that hold between organisms (constituted by brains *&* bodies) and their environments (Barrett 2011; Bickhard & Terveen 1995; Brooks 1999; Clark 1997; Dreyfus 1992; Franklin 1995; Hutto & Myin 2013; Noè 2004; Pfeifer & Scheier 1999; Robbins & Aydede 2009; Shapiro 2011; Varela et al 1991).

SC is a developing, rather than fully fledged research paradigm, nonetheless, it has some core tenets of its own (see, Anderson 2003; Calvo & Gomila 2008; Robbins & Aydede 2009). These have historical antecedents in two distinct but connected strands of research, one scientific the other philosophical. The scientific strand stems from cybernetics and psychology, particularly the work of Ashby, Bateson, Vygotsky and Gibson, all emphasised the reciprocity between perception, action and environmental feedback in cognitive processes (Dupuy 2000). Similarly in philosophy, the views of Dewey, Merleau-Ponty, and Heidegger stressed the role of the body and body-environment interaction in perception and knowledge (Gallagher 2009).

So *situated* cognition is not just a particular *type* of cognition which can be distinguished from non-SC. Rather, as a loosely unified research program, theorists of SC argue that cognition is *essentially* situated and that any abstraction away from the environmental context in which it unfolds, will severely distort the phenomena under study. Cognition not only evolved and adapted within an environment but it is also shaped by and shapes it in return. Moreover, cognition is not only situated but also essentially *embodied*. Thus the particular structural constitution of a system itself deeply constrains, modulates and nontrivially contributes to cognition. According to Anderson (2003);

> Instead of emphasizing formal operations on abstract symbols, this new approach focuses attention on the fact that most real-world thinking occurs in very particular (and often very complex) environments, is employed for very practical ends, and exploits the possibility of interaction with and manipulation of external props. It thereby foregrounds the fact that cognition is a highly embodied or situated activity—emphasis intentionally on all three—and suggests that thinking beings ought therefore to be considered first and foremost as acting beings (ibid, p. 91).

From the SC perspective, cognitivism focused too narrowly on programs and algorithms for specialised kinds of "off-line" thinking (in the head), such as abstract reasoning and logic, as a consequence "on-line" *active* cognation was completely neglected. It is this narrow conception of cognition as *detached* and *disembodied* that SC challenges. Accordingly, cognition needs to be put "back in the brain, the brain back in the body, and the body back in the world" (Wheeler 2005, p 12). Ultimately, cognition can no longer be understood exclusively in terms of disembodied abstract computations happening in the head.

Note that this "movement" goes under various names and is associated with a motley of diverse notions and closely related ideas, such as; *embodiment, enactivism, distributed cognition, dynamic hypothesis, sittuatedness* and *the extended mind.* Moreover, these ideas also go by a host of different labels including, but not restricted to; "distributed cognition", "New AI", "embodied cognitive science", "radically embodied cognitive science", etc (see Calvo & Gomila 2008; Chemero 2009; Robbins & Aydede 2009). Here however, I opt for the umbrella term *situated cognition* (SC). The motivation for using SC rather than the more prominent "embodied" cognition is a partisan one.

This is because a great deal of work currently done under the banner of "embodied cognition", does *not* in fact deal with the *body* in any meaningful way at all, nor offer any theory of embodiment as such (Froese & Ziemke 2009; Ziemke 2001; 2003; 2007).

Thus, the common usage of the terms *embodied* cognition, *embodied* cognitive science etc, seems inappropriate (Wilson 2002,[3] is a good example of this). Given the neglect of the body, SC seems to be a more appropriate label for the *current* state of the approach. Nonetheless, for the purpose of this work, although all of the above mentioned approaches difference in certain aspects with regards to this or that theoretical concept, they contain some commonalities, on which I shall focus.

Following Robbins & Aydede (2009), I take SC as the genus and embodied, embedded, enactive and extended cognition etc, as species thereof. That is, these species can be understood as distinct yet loosely connected approaches to SC As already noted, these ideas are by no means homogenous nor all adhered to by everyone. But, just as cognitivism has its theoretical core, so too can we identify a similar core to SC. In particular there are three ideas which are central and unifies most of the research, giving the program its underlying theoretical foundations. These key tenets are, *embodiment*, *embeddeness* and *extension.* Together they form the theoretical core of the genus of SC. I introduce these next.

2.2 - The Alternative View in Three Theses

The first of these notions is embodiment. The idea here is that cognition depends not only on brains but also *essentially, non-trivially,* on bodies. Cognitive systems possess physical structures, other than brains or central processors, which enable them to navigate and negotiate their way around in the world. Cognition is understood as being embodied through-and-through. Call this the *embodiment thesis*.

Secondly, cognitive systems inhabit a *physical environment* which they are part of and not merely an abstract mental space. Cognition unfolds from a particular perspective, within a particular context in response to particular circumstances. In these cases we routinely use and exploit external resources which structure and facilitate these processes. These need to be considered and taken into account when thinking about cognition. Call this the *embedded thesis.*

[3] In her review article (Wilson 2002) identifies six different views of "embodied cognition", only one which explicitly addresses the role of the body (see Ziemke 2003).

Leads straight to the view that the *boundaries* of cognitive systems are (at times) *extended* into the environment. That is, some of the resources used by cognitive systems can become *constitutive* parts of the system itself and extend cognition beyond the head. Call this the *extended mind hypotheses* (EMH).

Together, these loosely provide the theoretical underpinnings of the SC framework. To a large degree, for SC the most fundamental of the three theses are embodiment and embedding (Brooks 1999). Some argue that by endorsing either of these one need *not* endorse the idea that cognition extends into the environment. Accordingly, the extension thesis is said to be the most "radical" and also the least endorsed by the wider SC community (Wilson 2002). Indeed, cognitive extension is often used to distinguish between *merely* "embedded-embodied" views, which are argued by the EMH theorists to be the exclusive "conservative" purview of SC, and the more "radical" *extended* view (Clark 2008; Rowlands 2010; Wheeler 2011a; 2013). Thus the EMH on its own is considered as a distinctive stand-alone approach to the study of cognition.

For the purpose of this work we follow suite and take the EMH, *as a distinctive approach to SC*, in the same way that "embodied cognition" or "distributed cognition", can be understood as a distinctive approach to SC. It is largely on this basis which we will appraise it. This we will do in the next chapter.

Conclusion

The aim of this chapter was to introduce the notion of cognition and how it is understood by cognitivists and SC. The EMH was considered a part of the SC movement.

Chapter Two
The EMH In Context

Introduction

This chapter is divided into two interlinking halves. The first introduces the EMH as advocated by Clark and Chalmers (C&C) in their 1998 paper *The Extended Mind.* The second appraises the EMH in relation to cognitivism and SC This appraisal will lead to the conclusion that the EMH is a Janus-faced proposal, in that it is motivated by and portrays itself as a "radical" form of SC, yet clings on to traditional cognitivism.

1 The Case For EMH

1.1 - Extended Cognition

As already noted, the idea behind the EMH[4] is that things other than brains, can *ontologically* count as parts of a cognitive system. But how does this differ from the more standard SC claims? The EMH self-consciously distinguishes itself from SC, claiming that embodied-embedded SC, is *not "radical" enough*. Due to the explicitly ontological nature of the perspective, it is hailed by proponents and critics alike, as a "radical" departure from, not only cognitivism, but also from SC itself (Adams & Aizawa 2008; Clark 2008a; Rowlands 2010; Rupert 2009; Wheeler 2010; 2011a; 2013). Here we explore some of its central arguments.[5]

The EMH is an answer to a question posed by C&C; "where does the mind stop and the rest of the world begin?". Accordingly;

> The actual local operations that realize certain forms of human cognizing include inextricable tangles of feedback, feed-forward, and feed-around loops: loops that promiscuously criss-cross the boundaries of brain, body, and world. *The local mechanisms*

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[4] See Menary (2010) for a overview and representative sample of approaches to the EMH.

[5] Due to space constrains this work only addresses so-called "first-wave" approaches to the EMH (see Menary 2007; 2010a,b,c; Sutton 2010). Nonetheless, *all* points made here, equally apply to the "second-wave" approaches. Elsewhere (De Jesus, under review) I have argued that second-wave approaches are also grounded on functionalism, and so, are inherently cognitivists. That said, this is an issue which cannot be addressed here

> *of mind, if this is correct, are not all in the head*. Cognition leaks out into body and world" (Clark & Chalmers 1998. p,12 emphasis added).

It postulates that the *mechanisms* of cognition *sometimes* extend beyond the skin. Consider a simple example, the use of pen and paper to solve a mathematical sum (Clark & Chalmers 1998; Wilson & Clark 2009; Rumelhart et al. 1986). When faced with a simple sum, such as 7 x 7, most people can easily "see"' the correct answer. When it comes to longer multiplications however, the answer becomes difficult to "see". In these cases a standard strategy is to use pen and paper to work it out. C&C (and more substantially Wilson & Clark) claim that, on the occasions we use pen and paper to solve sums, the cognitive processes involved are *literally extended* into the world and the pen and paper form *part* of the cognitive machinery. Pen and paper are *constituent parts* of the cognitive process not merely *causal aids*.

Wilson & Clark offer several reasons for this ontological claim. They point out that if I do the calculations without the aid of pen and paper, I would need to internally represent the figures and perform the entire calculation "in my head". Had the task been performed in this "standard" manner, there would have been no hesitation in calling it a genuine cognitive process. But, the task can also be performed by writing the intermediate results down and "off-loading" part of the cognitive routine onto the piece of paper. The numbers which would have had to be internally (in the head) represented, manipulated and stored, are *externally* represented, manipulated and stored. As such, since pen and paper support and actively contribute to the off-loading, manipulation and storage of the information required for solving the calculation, they *fulfil the same cognitive functions* that short-term (internal) memory would in its absence. Therefore, we should grant it cognitive status, as exclusive in-the-head processes.

The use of external resources to perform a cognitive task (multiplication) aids, augments and constitutes our mathematical abilities. Pen and paper can take over the *function* which would normally be performed by neural resources (i.e. short-term memory). For this reason, Wilson & Clark argue cognitive processing *extends* into, is *constituted* by, these two external objects.

Consider doing a jigsaw puzzle. Imagine how difficult this task would be if you couldn't physically interact with the pieces, without the ability to pick them up and manipulate them. A traditionalist account of how one builds a jigsaw, suggests that for example, one first forms a mental image of the particular piece then mentally rotates it to establish its best fit. All of which is implemented by computational processes *in* the brain. However, taking the above ideas on board, *manipulating* the pieces can do much of the work of internal cognitive processing. As Wilson (2004) argues;

> We solve the problem by continually looking back to the board and trying to figure out sequences of moves that will get us closer to our goal, all the time exploiting the structure of the environment through continual interaction with it. We look, we think, we move. But the thinking, the cognitive part of solving the problem, is not squirreled away inside us, wedged between the looking and the moving, but developed and made possible through these interactions with the board (ibid, p. 194).

Because we can *physically manipulate* the pieces much of the burden of internal mental imagery processing is relieved and extends cognitive processing beyond the brain.

The distinction between cognitive behaviours and cognitive processes, introduced in Chapter 1, can help further illustrate the idea. Recall that cognitive behaviours are those observable patterns displayed whilst performing a particular cognitive task, such as calculation. While the cognitive processes are the *mechanisms* responsible for that task. Traditionally these processes have been conceived as located entirely *within* cognitive systems, but for the EMH, this is not always the case. In *some* cases the cognitive processes, *the mechanisms which realise cognition*, partly extend beyond these boundaries and are *constituted* by extra-neural, extra-bodily resources.

In sum, by "coupling" agent to environment, cognitive tasks are less computationally expensive than traditional (in-the-head) problem solving routines. They are computationally efficient in virtue of reducing the cognitive complexity and thus enabling the agent to solve less representation hungry problems. Furthermore, for the EMH theorist external resources are *ontological constitutive parts of a larger integrated coupled cognitive system*. This claim in particular makes the EMH a *constitutive thesis* rather than merely a causal one (more on which below) and is its *essential core* claim, that which sets it apart from merely embodied-embedded SC.

1.2 - Extended Minds

Having introduced some arguments for the extension of *cognitive processes*, we now turn to the extension of *mental states*. C&C (ibid. p,12) point out that, even if cognitive processes are extended, this does not guaranty that *mental states* "extend". The view that cognitive processes extend into the world *is compatible*, so maintain C&C, with an internalist position arguing that such mental states as *believes, desires* and *emotions* occur exclusively in the brain. So, C&C present an argument which aims to convince us that a certain class of mental states, primarily propositional attitudes (including the vehicles thereof), are also not bound by the boundary of skin and skull.

C&C offer the following thought experiment. Inga, a NY native, is an avid art lover who frequently visits art museums. While reading her local paper, she sees an advert for an art exhibition at the Museum of Modern Art (MOMA), which she likes the look of. Recalling that MOMA is on 53rd Street, she gets ready and promptly walks there. Inga's behaviour can be understood in terms of personal level mental contents, we can say that Inga *believed* that MOMA was in 53rd and *desired* to go there. Imagine another NY resident, Otto who has a form of mild dementia, which impairs his memory. In order to combat this impairment, Otto always carries with him a notebook in which he writes new and relevant information. When Otto needs to access some old information, he simply looks in his notebook. Now, Otto also happens upon the same advert and like Inga, also desires to go and see it. He promptly looks in his notebook, sees that MOMA is in 53rd Street, and off he goes.

For C&C, this thought experiment shows that Otto's use of the notebook, counts as a genuine case of an *extended mental state*, that of *belief*. To make this clearer, let us consider the status of Inga's belief. It seems plausible here to claim that Inga believed that MOMA was in 53rd Street, before she consulted her memory. So from the first time she learned that MOMA was on 53rd Street she held this belief. The distinction between *dispositional* and *occurrent* will help here. A dispositional belief is a belief one has but is not currently entertaining, while an occurrent belief, is one which is brought forth to consciousness. Thus, Inga's belief becomes occurrent when she remembers it but she does not stop believing it when it becomes dispositional.

Next, C&C argue that Inga's biological memory and Otto's notebook are *essentially on a par* with each other,

> ...entirely analogous: the notebook plays for Otto the same role that memory plays for Inga. The information in the notebook functions just like the information constituting an ordinary non-occurrent belief; it just happens that this information lies beyond the skin (ibid)

If someone asks Inga whether she knows where MOMA is, she says its on 53rd Street. Similarly, when Toto who is Otto's friend, asks if he knows where MOMA is, Otto automatically takes out his notebook, locates the address and proceeds to tell Toto that it is on 53rd Street. The point is that, *both* the notebook and biological memory play *exactly the same functional role* with regards to guiding behaviour, although one is located within the brain the other in the world.

1.3 - Constitution

We noted that the EMH is a constitutive thesis which argues that the coupling between internal processes with external resources form a *unitary coupled system*. Thus,

> In these cases, the human organism is linked with an external entity in a two-way interaction, creating a *coupled system* that can be seen as a cognitive system in its own right (Clark & Chalmers 1998).

It is important then, to be clear on exactly what sort of claims are being made here. The arguments above are not claiming that cognitive processes which extend into the environment are *completely* external (more in the following chapter). Rather, the idea is that these processes are "hybrid" processes (Rowlands 1999) which incorporate both internal *and* external components in its overall functioning, hence coupling. Moreover, these hybrid processes are constitutive cognitive process made of inner and outer components. External resources, do not merely causally aid cognition (although admittedly C&C seem to slip from causal to constitution easily), they actively *constitute* cognition.

This should clarify why the distinction between, merely causal and ontologically constitutive, is crucially important for the EMH. It is this distinction which is claimed sets the EMH apart from other SC. From the perspective of the EMH, SC amounts to the assertion of *partial* extension, and thus less radical than the EMH. The EMH theorist thinks of SC's theorist as simply stopping functional extension at the *boundary of the body*. Many theorists might have no qualms with the idea that external resources *causally* contribute to cognition. Indeed, some of these theorists incorrectly think that this is all there is to SC (cf. Adams & Aizawa 2008; Rupert 2009). So, although we might in some important ways crucially depend on external resources to support cognitive activities, this does not imply that cognition is constituted by these structures, cognition remains *in the head*.

To strengthen their claims, C&C supply the following criteria for the constitution thesis. (1) All the components in the system play an active causal role. (2) These jointly govern behaviour in the same sort of way that cognition usually does. (3) If we remove the external components, the system's behavioural competence will drop, just as it would if we removed part of its brain (adapted from Menary 2010c. p, 3). Therefore, environmental components play an active role in the present here-and-now, not only in influencing but also constituting our cognitive performances. Were we to maintain internal structures as they are but alter the nature of our environment, chances are our behaviour and cognitive competencies would change dramatically. Sometimes external resources are as constitutively relevant as internal brain processes.

However, by itself, this criteria is not sufficient to establish whether a particular coupled system is *cognitive* as such. There are certainly plenty of coupled systems which are clearly not cognitive. A thermostat for example; one might argue that it is coupled with the room and temperature. All the components in this system jointly play a role in its functioning. Removing a component of this system would surely impede it from performing its intended function. Nonetheless, this system is arguably *not* cognitive. The question now is; how and why are we to establish when a coupled system is *cognitive?* C&C's answer to this question comes in the form of a principle known as the *parity principle.*

1.4 - Parity

If location no longer provides the criterion for what is and isn't cognitive, then what does? In order to determine whether external resources count as a part of a larger cognitive process, and which kinds of coupling constitute genuine cognitive systems, C&C offer, as a guide, what has become known as the *parity principle* (PP). The PP suggests that;

> If, as we confront some task, a part of the world functions as a process which, were it done in the head, we would have no hesitation in recognising as part of the cognitive process, then that part of the world is (so we claim) part of the cognitive process. Cognitive processes ain't (all) in the head! (Clark & Chalmers 1998: 8).

The PP has been notoriously difficult to interpret and the source of plenty confusion. Unsurprisingly really, since on a first reading, it appears contradictory. On the one hand, the principle claims to provide a non bias location-neutral principle to demarcate the cognitive. Whilst on the other hand, it argues that "were it done *in the head*", then we should consider it cognitive. Thus suggesting that the true benchmark of the cognitive *are* internal brain processes after all (Di Paolo 2009; Gallagher 2009; Walter 2010).

On a more charitable reading, the PP suggests that if the external structures that underwrite the process were inside the head, we would have no problem claiming the process to be cognitive (Clark 2008a, p.114). Naturally, C&C do not mean that external structures can literally be present in the same form inside the head. Pen and paper used to perform calculations, or Otto's notebook, is not literally implanted inside the head. What C&C have in mind is a *parity of function* between a cognitive process that uses a part of the world outside the head and a cognitive process that occurs solely inside the head. Calculating using pen and paper, which is an external process in the cognitive task, is *functionally isomorphic* with calculation *inside* the head, which is an internal process. As we have no problem describing the latter process as cognitive, we should therefore have no problem describing the former process involving pen and paper also as a cognitive process. Thus understood, the *location* of a process should be *irrelevant* to its potential status as cognitive, *functional role* is what matters most

Evidently the PP is a *functionalist principle,* Given that the EMH argues that nonbiological resources form part of wider cognitive system, adopting a functionalist view of the mind makes issues regarding the particular material nature of these processes, instantly less pressing. In this sense at least, functionalism of a sufficiently liberal type, can be seen as something of an "ideal" theoretical framework. Recall that functionalism characterises the mind in terms of a *substrate neutral* network of causal input-output relations. Individual mental states/cognitive processes, are characterised by their function, or the role they play, within this system of inputs and outputs (Block 1980). However, nothing stops these input-output relations from *spreading out across brain, body and the world*. Indeed, this seems to be a natural implication of this doctrine (cf. Sprevak 2009; Wheeler 2010).

According to C&C, whether a state counts as a belief, is in part, determined on the basis of the causal/functional role it performs. It is irrelevant where the substrate of this causal role is located. It can be located within the confines of the biological body, or span the brain, body and world boundary. The point is that, for C&C, what makes something a belief is the *causal relations* it entertains to inputs, outputs and other mental states, *not* the physical substrate. The Otto example is particularly instructive in this respect, because it appears to provide strong theoretical support for this claim, showing that beliefs, a paradigmatic case of mental states, can supervene on mechanisms that are distributed across brain, body, and world

The exact location of the physical realisation of the functional role is irrelevant to the functional level of description. Since the notebook is functional isomorphic to Inga's memory, by dint of parity, we have no justification in denying Otto's belief as being (in part) extended beyond the skull. The only thing that would prevent us from doing so is, according to C&C, an internalist bias. The entries in Otto's notebook should be understood as dispositional beliefs just as the ones in Inga's biological memory because they equally guide behaviour and are functionally equivalent, by parity, Otto plus notebook constitute a coupled system.

Some critics however (Adams & Aizawa 2008; Ruppert 2004, 2009; Sprevak 2009) have noted that advocating such liberal (functionalist) conceptions of cognition are so permissive that any external process is potentially cognitive, overextending the mind and leading to "cognitive bloat" (Rowlands 2009). To deal with this issue, C&C provide some additional criteria, the "glue and trust" conditions which external processes have to meet in order to be considered as proper parts of a cognitive system.

> 1) That the external resource be reliably available and typically invoked. 2) That any information thus retrieved be more-or-less automatically endorsed. It should not usually be subject to critical scrutiny (unlike the opinions of other people, for example). It should be deemed about as trustworthy as something retrieved clearly from biological memory. 3) That information contained in the resource should be easily accessible as and when required. (Clark 2008a. p, 79)

The extra criteria are offered as a means of tightening up the over permissive liberal functionalism which grounds PP. The details of the debate surroundings the EMH and functionalist is not significant for my overall thesis, the only point to bare in mind is that by in large, the EMH is defended in functionalist terms (but see Menary 2007; Sutton 2010).

In sum, the EMH draws a distinction between mind and cognition and defends the idea that, sometimes these internal processes are not only augmented by external resources, but constituted by them. It maintains that to understand cognition, we need to recognise not only how we interact with the outside world, but also how aspects of the nonbiological world are, in certain situations, actually constitutive parts of mentality. Unlike cognitivism, cognition should no longer be considered a heady affair, and unlike SC, it is more than an embodied-embedded affair - its extended!

2 The Janus-Faced Nature of the EMH

The aim of this section is to show that the EMH is a variant of cognitivism which makes it a Janus-faced proposal. It draws inspiration from the SC framework yet clings to cognitivism. We therefore appraise it in retaliation to *both* cognitivism and SC. My central concern here is not to address any of the well documented criticisms of the EMH, but only to illustrate that it is best understood as a cognitivist proposal.[6]

2.1 - SC or Cognitivism?

So, what exactly are we to make of this account of cognition? How does it relate to SC and cognitivism, are the cries of radicalness and novelty merited? Having introduced some of its central arguments, we are now better placed to elaborate our claim that it is a *Janus-faced proposal*. But what exactly do we mean by this? The general idea stems from the observation that the EMH is at once motivated by SC yet remains *fully committed to cognitivism*. This will strike most, as at best odd, and at worse contradictory. How can I present the EMH as an approach to SC yet claim that it clings to traditional cognitivism?

As we will now see, although C&C claim to find traditional cognitivism inadequate, it is nonetheless also clear that they remain equally committed to it. Alas, these inadequacies lie *solely* with the cognitivist conservative boundary drawing. Nonetheless, it continues to hold on to all its major theoretical assumptions and commitments. The three theses of traditional cognitivism identified in the Chapter 1 get incorporated into the EMH. It is the purpose of this section to justify this observation.

2.1.1 - EMH & Individualism Thesis

While it is certainly true that the EMH makes some gallant attempts at conceptually freeing itself from the clutches of dualistic thinking in cognitivism, it is equally true that it falls somewhat short off the mark. The central issue is that, in its negative formulation it depends on and derives from, taking the Cartesian way of thinking as coherent. To argue that the mind is extended in this manner, is to merely redraw the spatial boundary, rather than to *dissolve or question* it. It *does not* make any attempts to question the very *foundations* of centuries of study on the nature of cognition.

The theoretical landscape of the EMH debate *presuppose* and *preserves* the dualism of an inner/outer dichotomy. Assuming that the terms "inside" and "outside", are

[6] In Chapter 4 sect 2.2, I offer some reasons why it fails as a general account of cognition.

meaningful and unambiguous. In so doing it commits itself to the individualism thesis. This is further evident in the fact that, proponents of the EMH continue to take brain processes as the *true locus* of cognition, only *occasionally* do these get extended. Here the central core of cognition continues to be the product of mostly "isolated" bounded *individuals,* or more accurately, their mental states, which occasionally extend (Clark 2008a,b; Wheeler 2011a).

Thus the problem with the EMH, particularly as a *self-proclaimed alternative* to cognitivism, is that it simply continues to preserve the Cartesian inner/outer dichotomy, and with it its grounding assumption that, the basic way of relating to the world is through propositional representations (cf, Dreyfus 2007; Gallagher 2011). As Gallagher (2011) points out, the EMH preserves a model of mind which it claims to want to reject. Thus the three criteria used to tighten up the PP and fed-off cognitive bloat, are worked out in terms of beliefs then generalised to *all* cognitive processes. Cognition is predominantly constituted by beliefs, desires and other propositional attitudes conceived in terms of representations and informational states. The Otto thought experiment is a paradigm example of this commitment to the individualism thesis. Cognition is here portrayed as the product of a rational self-contained bounded unit endowed with causally efficacious mental states, who perceives, plans and finally acts on the environment on the bases of these states. Otto's behaviour is guided by these representational states and nothing else.

So, while the EMH challenges traditional intuitions regarding *where* the boundaries of the mind and cognition should be drawn, it does not challenge much else. In *essence* then, the EMH is simply a thesis about *boundaries*. With this issue as its central concern, the underlying traditional cognitivist intuitions regarding *what* cognition is, simply falls out of the radar. Consequently, traditional bias, intuitions and prejudices simply get incorporated into its own "extended" position.

Ultimately, what C&C have done is preserve the traditional understanding of cognition in terms of discrete mental states causally governing behaviour, but simply placed these outside the head. However, the conceptual/theoretical machinery remains the same, only the location of these states have changed.

2.1.2 - EMH & Computationalism Thesis

The computationalist thesis is the most prominent and *explicitly* endorsed thesis out of all three cognitivist theses. To see this, we simply need to note, evident already in the above discussion, that the EMH is articulated *within* the conceptual framework of the computational/functionalist theory of mind. Clark himself is rather clear on this issue, as he remarks in defence of EMH;

> *…computational, representational, information-theoretic, and dynamical approaches (are all) deeply complementary elements in a mature science of the mind* (Clark, 2008a p. 24, emphasis in original).

The commitment to the computational thesis is also particularly evident in C&C routine use of such notions as "computations", "information-processing", "representations" and "functional roles", all of which are key concepts used in the cognitivist paradigm. Once again, mind and cognition is taken as theorised by standard cognitivism, and then extended outwards.

But cognition remains a computational information-processing enterprise, a matter of the right *functional organisation*. Knowledge is grounded in a "storehouse" of either mental or external representations, which can be reliably called upon when required to guide goal-directed behaviour. Inline with traditional cognitivism information-processing is taken to be the essence of thought and cognition. But for the EMH theorist some of this information processing just happens (sometimes) to be realised beyond the brain. In other words, it is traditional cognitivism, but extended. The cognitivists conceptual framework, along with its grounding assumptions of mind and cognition, thus remain completely intact and critically unchallenged.

Again the Otto thought experiment strikingly epitomises these guiding intuitions and the model of cognition underpinning it. Evidently C&C implicitly take the mind to be a kind of repository for propositional attitudes and information. The notes in Otto's notebook are very much like files in a filing cabinet. This model suggests that memory is some kind of store, from which records are retrieved. On this view, memories are stored static representations which represent the original event, these representation in turn provide a causal link between that particular episode and a person's ability to remember it. Put simply, this is nothing but GOFAI (Haugeland 1985) in its purest form. Not that Clark himself seems to mind, since he freely admits that the “mind is *essentially* a thinking or representing thing" (ibid. p, 149, emphasis added).

2.1.3 - EMH & Anthropogenic

Finally, evidently the EMH is also thoroughly committed to an anthropogenic approach to cognition. This should come as no surprise, given that it is at its core cognitivists and as we have seen, cognitivism is itself deeply anthropogenic. Like most traditional accounts of cognition, the EMH take (adult) human cognition as its starting point. Thus cognition always amounts to highly sophisticated cognitive skills such as language, decision-making, and problem-solving. Indeed, the majority of examples offered as support for the EMH are those of highly complex human cognitive capacities.

Cognition below the level of humans is seldom acknowledged. In so doing, the EMH continues to perpetuate a distinction between basic cognition and higher levels of cognition. Consequently, implicitly implying that cognition can be understood without having to understand basic forms of cognition and that cognition is simply, a human-only affair (see Menary 2010 for a representative collection).

In conclusion, we appear to have a good case for understanding the EMH as a type of cognitivism. It *assumes* and *defends* a model of the mind which it incorrectly claims to be challenging. It does not sufficiently challenge nor does it offer a "radical" alternative to cognitivism, it merely extends it. As Shapiro (2011) notes, the most fruitful way to understand the EMH is as a type of, what Wilson calls, "wide computationalism". This is a view which, despite what some might think, is completely compatible with the mainstream cognitivism. Note also that, like cognitivism, cognition is demarcated by ascription.

Taking this into account, I suggest that the EMH is then best seen as *supplementing* traditional cognitivism rather than as a principle argument against it (Chemero 2009; Di Paolo 2009; Dreyfus 2007; Gallagher 2011). As such, it is a mistake to see it as competing with cognitivism, as most critics of the EMH argue (Adams & Aizawa 2001, 2008; Fodor 2009; Rupert 2004, 2009).

2.2 - EMH & SC

But what about its relation to SC more generally? Ultimately, it proposes a reconciliatory picture, but as we have seen the insights from SC are simply integrated into the old cognitivist model, where representations and computations are still the keystone of cognition, and mental processes keep their platform-free privilege. Only now the body and the environment are as important participants as the brain is. And while there might be merit to such a position, it needs to be kept in mind that, it just ain't non-cognitivist!

We are now better placed to see the Janus-faced nature of the EMH. On the one hand, the EMH as presented here was greatly inspired and motivated, by the development of SC as a research program. To a large extent, it is the development of SC which ultimately opened up the intellectual space for the EMH to be articulated, defended and generally understood. Thus, regardless of how it sees itself in relation to SC, the EMH has its roots within it. However, having exposed some of its theoretical assumptions, it should now seem less radical and more common place. Thus understood, one of the central motivation for endorsing the EMH in the first place, the conviction that traditional accounts of cognition had outlived its usefulness, an insight stemming from SC, gets completely eroded.[7]

In sum, the EMH as a distinct approach to SC remains deeply in the shadow of cognitivism. Due to its unquestioned assumptions about what cognition is, its claims amount to little more than functional analyses of the various ways humans interact external resources in order to reason, seek out information, make plans etc. Even though the EMH has revised the boundaries of cognition this has not in actual fact changed the underpinning cognitivist framework it wanted to undermine. Therefore, initial appearances notwithstanding, the EMH remains a cognitivist doctrine.

[7] It is worth noting that the relationship between other approaches to SC and cognitivism, isn't entirely straight forward either. Suffice it to say that, there is in fact lots of reasons to think that most of SC amounts to little ells than dressed-up cognitivism, but this cannot be pursued here (see, Chemero 2009; Hutto 2011a; Hutto & Myin 2013).

Conclusion

The aim of this chapter was to present the EMH and highlight its true Janus-face. It was argued that despite initial appearance, the EMH remains a form of cognitivism which mostly concerns boundaries.

Chapter Three
Motivating The MoC

Introduction

The central aim of this chapter is to motivate the request for a "mark of the cognitive" (MoC). But contrary to current debates, I present some reasons for understanding this request as an opportunity to question traditional cognitivism not to settle boundary disputes. I begin by arguing that disputes about boundaries are counter productive which can only be dissolved not resolved. I then explore the MoC with regards to current debates within the EMH. I conclude by introducing preliminary requirements for an alternative MoC.

1 Bound by Boundaries.

Before we can address issues to do with a MoC, we first need to reconsider the nature of boundaries. At the end of the previous chapter we argued that the EMH is mostly concerned with boundary issues. But if the EMH is understood as *merely* the redrawing of a special kind of boundary, then one might legitimately wonder how much is truly gained from this. Is there any benefit from endorsing an *extended* cognitivism? In this section, I argue the answer is *no* and provide some reasons for why arguing about boundaries, is not only unhelpfully distracting but can only end in aporia.

1.1 - Unbounded by Boundaries

A common assumption held by both proponents and critics of the EMH is that there *are* fixed boundaries to the cognitive.[8] This is the case even though the proponents of the EMH argue that *sometimes* these boundaries extend into the world. As we saw, it is this preservation of the Cartesian inner/outer dichotomy that saddles the EMH with the individualism thesis. However, the idea of living systems with fixed intrinsic boundary, has proven to be a somewhat problematic assumption (Bateson 1972).

[8] This is simply a natural consequence of assuming that cognition is an object (as opposed to process) and hence spatially located. This assumption is challenged in the following chapters.

Dominique Chu (2011) has made a good case that *all* complex adaptive systems (CAS), systems with rich and diverse connections to the environment, are by their very nature "radically open" and *cannot have fixed boundaries*.[9] These systems are *self-organising*, meaning that they are composed of subcomponents forming dynamic networks of mutual interactions, which give rise to *emergent properties* (order & structure) not found among, nor capable of being deduced from, the underlying subcomponents (Holland 1999). They evolve and spontaneously regulate their behaviour so as to *adapt* and cope with ongoing changes in its surrounding environment through multiple feedback loops (Érdi 2008; Juarrero 1999; Mitchell 2009). Such systems range from cells, to crowds and societies and are always evolving, dynamic and radically open. It has become apparent that drawing neat boundaries around these systems is nearby impossible. This becomes particularly evident when such systems are modelled.

To model a particular CAS, a researcher will first present a "semantic model" which describes the system, then a process of abstraction will ensue, leading to "formal models". This process inevitably involves a *normative* dimension, as the researcher must make choices, judgements, and assumptions when deciding on the factors that are relevant to the model. The modeller is always faced with a choice as to what to include and what to leave out from the model and consequently where the boundaries are to be drawn. Where boundary are placed will depend on the nature of the enquiry, what needs to be known and ultimately who wants to know and for what purpose. It depends on the goals and aims of the researcher *not* on any further fact of the matter. Ultimately, the boundary between system and world is simply a *pragmatic* one which will change case by case depending on the purpose and aims of the enquiry (Bateson 1972; Rockwell, 2005; Susi et al 2003).

Fixed boundaries then seem to simply be *observer relative*. Some will argue that all this shows is the *epistemic difficulty* to modelling and nothing about the *ontological status* of boundaries themselves. There are however also reasons to doubt this.

[9] CAS's are also dynamic, *open and far-from-equilibrium*, meaning that they exchange energy and matter with the environment in order to maintain stability. This topic is further discussed in Chapter 5&6.

Alan Rayner (1997) for example, observes that living systems (a type of CAS) are not composed of a series of discretely bounded units. A careful study of the physical nature of living systems presents plenty of reasons for thinking that fix boundaries would simply be *catastrophic*. As Rayner illustrates through countless examples, the boundaries that appear to separate one organism from another, one cell from another, are, and *essentially need* to be, fluid, dynamic and utterly context-dependent. A cell membrane for example, is not there simply as fixed barrier or a kind of "container", rather, it expands, contracts and is able to dynamically adapt to ongoing change. It is porous, allows inside and outside environments to mingle and flow together.

Similarly, at a higher-level, an organism's boundary *needs* to be equally dynamic, since organisms of all kinds are embedded in complex webs of relational interdependence, which are essentially required for their survival. Indeed, since living systems are in effect defined by the types of relations they can enter into, if you can draw an absolute boundary around them, then they cannot be interacting and changing, but if it is changing then it cannot have an absolute fixed boundary. The same principle should apply to any cognitive system in general. Living organisms as a type of CAS (see chapter 5&6), are constantly on the move, they have varying goals, needs, desires, values and purposes which change on a moment-to-moment basis, all of which require complex skilful navigation of the environment. By virtue of this skilful navigation, this exploration and goal-directed behaviour, such systems *demand* fluid boundaries.

If we take these considerations into account, it suggests that there is very little point in disputing *where* exactly the boundaries of cognition are to be drawn, as they are impossible to truly pin down. As such, they will always be constrained and dependent on the nature of the enquiry. And if this is the case, then there is no, there can *never* be, a *fact of the mater* regarding the boundaries of cognition. It is not a dispute that can be settled by argument nor by empirical investigation. As long as it is simply a dispute about boundaries, a stalemate will ensue. And here is the problem, since what sets the EMH apart from other approaches to cognition, is its particular taken on boundaries. *Without the boundary dispute there would be no EMH.*

So where does this leave the EMH? If all it has to offer is a redrawing of a boundary, then it seems unclear how beneficial it is. Even more so now we have argued that boundaries are in fact *pragmatically* drawn. If we accept this, then much of the debate surrounding the EMH simply dissolves. What we *can* salvage is the intuition that *traditional cognitivism needs to be challenged*. This I believe is an insight worthy of pursuit, but one which, due to its cognitivist leanings, the EMH has been incapable of achieving. This intuition has been eroded by the ensuing debate's myopic focus on boundaries.

What these brief remarks on boundaries ultimately suggest is that a non-cognitivist account of cognition, unlike the EMH, *cannot* be bounded by boundaries. Therefore the focus needs to shift from arguing about *where* boundaries should be drawn, to questions about *what* cognition is. If we do so, then we might be able see, insofar as the locution actually makes any sense, *where* cognition is, *but,* we also dissolve the EMH dispute. What this shift of focus ultimately implies, is a *demand for a "mark of the cognitive"* (MoC). A principle of demarcation for establishing what makes systems cognitive in the first place.

2 The EMH & The MoC

Fred Adams and Ken Aizawa (A&A) have for several years now, been staunch critics of the EMH. Here I use their MoC argument to frame the issues of the MoC in general, and recast their demand for a MoC, as a call to *reexamine* intuitions about the nature of cognition itself.

2.1 - Why a MoC?

Lets first look at how the MoC is debated within the EMH literature. Some commentators have noted that the fact that there is such an intense debate regarding the boundaries of cognition, bears testament to the lack of a universally agreed upon MoC. The idea being that, if there was an established consensus on *what* cognition was, then as a natural consequence, we would find it easier to know *where* it was too (Adams 2010; Adams & Aizawa 2001; 2008; Rupert 2004; 2009; 2010; Weiskopf 2010)

Stemming from this observation, one of A&A's main argument against the EMH, is that it fails to provide any adequate demarcating criteria which would ultimately show that cognitive processes are extended. How can the EMH theorist argue, they ask, that cognition extends beyond the skull, if he does not specify a way of identifying instances of cognition. As they point out; "The bounds of cognition must be determined by finding the mark of the cognitive, then seeing what sorts of processes in the world have the mark" (2001, p. 46). For A&A it is clear that external resources simply *do not* have these properties.

Clark (2008a, p. 87) disagrees, he thinks that we can and should proceed without a MoC, arguing that the very requirement is misguided. The reason is that asking how external resources *are cognitive*, as A&A do, is cleanly wrongheaded. It is not that they are cognitive or non-cognitive, but that they play a *role* in cognitive routines. Therefore, A&A are wrong to deny external resources cognitive status. Given that memory for example, is already established as a cognitive process, there is nothing further to add because the nature of the cognitive process has already been assumed. Clark's point is that, there is a distinction to be made between, what makes a process cognitive and what the constituents of that cognitive process are. This being the case, external resources involved in extended cognitive processes, need not display properties exhibited by the system as a whole.

Although there is something correct about Clark's reply, it does not fully address A&A's deeper point. That is, to provide a MoC, *just is* to provide a criterion for what makes something a proper part of some cognitive routine that can be fulfilled by external objects. Granted that external tools do not have the same properties as brains, what is it about *coupled* systems (tools-n-all) that makes them cognitive? Walter & Kästner (2012) similarly argue that the EMH really does need a MoC. These theorists point out that, contrary to Clark's own protestations, when it comes to the EMH, the issue of a MoC acquires an added sense of urgency. The basic argument, is as follows: either we have an adequate account of what cognition is or we do not. If we do, then the debate is easily resolved and there should be no further need for a drawn out dispute over boundaries. On the other hand, if we do not, then the debate is clearly pointless, because we will not know what we are talking about. And without knowing we simply will be incapable of settling the dispute.

All these arguments suggest that, what Clark and the majority of EMH theorists fail to see is that, this issue can only be settled by providing an independently motivated account of what makes a process cognitive.[10]

Now, although there is something right about this suggestion, it misses the mark somewhat. The focus needs to first shift *away from boundaries*. As Di Paolo (2009, p. 10) puts it: "Before asking where it is we must first say what it is". But, if we take our discussion regarding boundaries seriously, then the request needs to be understood somewhat differently from current debates. Indeed, the focus of this debate is doubly misguided. Firstly, if boundaries are ontologically fluid, dynamic, context-dependent, and epistemically pragmatic, then there can be *no fact of the matter* where they are drawn. Therefore the request for a MoC needs to be understood *independently* of boundary disputes.

Secondly, this is crucial if we want to avoid falling into an inner/outer dichotomy trap and the individualism thesis. We thus have to start with the question of *what* it is that makes a system cognitive in the first place. Arguing that cognitive processes extend this or that boundary, not only tacitly preserves this distinction, but also continues to endorse the notion that there is an intrinsic boundary which can be uncovered. To avoid these issues, the starting point cannot be: is this cognitive process extended beyond the brain. Instead, we need to ask: *what* makes a system *cognitive?* A MoC is then first and foremost a way of *reexamining*, and if necessary *challenging*, traditional conception of cognition.

Arguably, one cannot specify the location of cognitive processes before establishing *what* a cognitive process is, but this does not imply that in so doing we will discover the

[10] Rowlands (2008; 2010) is one of the few EMH theorists who has attempted to provide a MoC. Here I do not address his proposal but simply note that it is in most respects an *extended* cognitivist MoC, based on cognitivists principles. Moreover it is premised on an assumption we have here been putting into question, that there *are* fixed boundaries to the cognitive. While Rupert (2009; 2010) offers an equally cognitivist account but organism bound MoC.

"true boundaries" of the cognitive. Again, we can only do so if we preserve the dualist (inner/outer) dichotomy, presupposing in advance that the cognitive has intrinsic fixed boundaries and that we can actually discover them. But we have already seen that this seems unlikely.

In sum, the demand for a MoC, needs and has to be, considered independently of boundary disputes. In so doing, the focus shifts from boundaries, towards considerations regarding the nature of cognition itself. It thus offers a chance to reexamine and challenge traditional notions of cognition, presenting a chance to start developing a truly non-cognitivist alternative. Finally, a MoC is required because I believe that demarcating the cognitive from the non-cognitive by *ascription*, is deeply unsatisfactory. This second point will however only be discussed in the next chapters.

Next, I will use A&A's own proposed MoC, as a means of elaborating these and further issues.

2.2 - The MoC According to A&A

A&A offer two necessary conditions as their demarcation criterion, for what counts as cognition, based on processes that involve the manipulation of representational states bearing non-derived contents. More precisely, these conditions are that, cognitive processes (1) involve *original content* (non-derived) and (2) have a *distinctive form of processing*. (2001, 2008, 2010). Accordingly, cognition *just is* neurally-based causal processing involving non-derived content. Now, granted that we need an unprincipled way of demarcating the cognitive from the non-cognitive, how adequate is this criteria?

First point to note is that this account requires (without any argument) that cognition *must* involve a brain or nervous system. This is a direct consequence of its underlying anthropogenic thesis. From this perspective, the behaviours of "simple" organisms which lack a nervous system such as jellyfish and unicellular organisms such as protists and bacteria cannot, as a *matter of fact*, count as cognitive. In A&A's defence this is the default assumption in cognitive science. But this should only be accepted, *if* it can be shown, beyond any reasonable doubt, that human beings (or organisms with brains) are the *only* genuinely cognitive systems.

There is an increasing amount of empirical research, from different fields, including micro-biology and comparative behavioural studies, lending support and evidence for cognitive abilities already in single-celled organisms (e.g., Ben-Jacob et al. 2006; Bitboll & Luigi, 2004; di Primio et al. 2000; Shapiro 2007; Taylor, 2004). All of these are converging on the view that the complexity of the behaviours of some unicellular organisms rivals that of organisms equipped with nervous systems or simple brains. Recent microbiological evidence shows that bacteria already exhibit complex cognitive-like capabilities that are often presumed to be precluded to organisms with centralised brains (Auletta 2011).

For example, some of the capacities found in bacteria include: indirect and modifiable stimulus-response couplings, robust sensory adaptation, memory, and social co-operation (Müller, di Primio, & Lengeler, 2001). The idea that prokaryotes are already capable of cognitive-like behaviours suggests that cognition represents a phylogenetically ancient adaptive process that evolved long before the establishment of cephalized nervous systems. This observation, which is gathering considerable empirical support, substantially undermines the brain-centric view of cognition A&A are advocating. Thus, we cannot simply assume, *a priori,* that cognition is just what *human* organisms do and then reduce these activities to brains. Given the increasing empirical evidence, we at least need an argument as to why this should be the case.

These consideration on their own should be sufficient to greatly undermine A&A's, or *any* other brain-based only proposal. More importantly however, what this indicates, is that we require a *non-anthropogenic MoC*.[11] One way to rescue this criteria would perhaps be to stipulate that it only applies to organisms with a nervous-system or just human cognition. But even so, the criteria still contains other problems.

Consider the first condition, the non-derived content requirement. A&A argue that, "a first *essential* condition on the cognitive is that cognitive states must involve intrinsic, non-derived content" (2001, p. 48). The first hurdle for this requirement is the lack of

[11] This issue is explored further in the next few chapters.

any consensus on what non-derived content actually *is*. But, putting this worry aside, the intuition behind the idea of non-derived content (Searle 1983), is that natural cognitive systems are distinctive because they possess content (understood as internal mental representations) not determined by social convention but intrinsic to the system.

A stop-sign for example, derives its meaning through social convention, but the mental representation of a stop-sign has its meaning intrinsically. While a stop-sign is a publicly accessible object and its meaning is determined by *social convention* the same could not be said about mental content. For A&A, the content of mental representations *cannot* be conventionally determined. We do not, cannot, take the group of neurones which make up a mental state and agree, by social convention, that they have the content of a stop-sign. Furthermore, A&A believe that neural states, and they alone, are *the* conduits for intrinsic non-derived content.

We have already briefly pointed out how Clark's reply undermines A&A's requirement for intrinsic content. There is a further problem lurking behind this requirement. This is because even cognitive states with non-derived content must have some derived content to it. Consider the thought of a stop-sign and assume it has been produced in sone naturalistic way. Now, it appears that this particular mental state cannot have all its content intrinsically, because this state on its own, cannot constitute the concept of a stop-sign. The concept of a stop-sign is derived from the social conventions that determine what it is, how it is used what it is used for etc. What this implies is that, although the state of having a concept of a stop-sign might arguably be partially non-derived, this state by itself cannot tell us what it is a content of. I cannot know what a stop-sign *is* upon encountering it for the first time. I might have some internal non-derived state of some kind, but this state by itself, is not enough to tell me what I am actually looking at. I need to know the context and social practices surroundings the use of this sign, and this clearly is not derived, but conventional (Menary 2010a,b,).

It thus appears that, demanding that cognition *exclusively* requires non-derived content, is problematic. Yet, *if* A&A only require that cognition involves *some* intrinsic content, then this is clearly not a problem for the EMH. Indeed, these would be more than willing to admit that some constituent parts of a cognitive process, will have some intrinsic content. Nonetheless, A&A can reply by pointing out that external components in these processes are merely *enablers* of the non-derived content and not constitutive of it. This exchange is particularly illuminating, as it clearly demonstrates the impossibility of settling the dispute when its played out in terms of boundaries. Only a MoC, *not motivated* by boundaries, will do.

What about A&A second requirement, that cognitive processes involves a distinctive form of causal processing. This requirement is directly connected to the first, cognition involves computational operations over states of non-derived content which are implemented in special kinds of *mechanisms* (distinctive form of processing). Thus cognitive phenomena differ from non-cognitive phenomena in virtue of the nature of these underlying processes (2008, p. 57). According to A&A, these processes (mechanisms) are fundamentally distinctive and we need to examine extended cognitive processes to establish whether they too possess this distinctive character.

We have already seen that this cannot be the whole story, but could it apply to human cognition alone? Most proponents of the EMH have replied by pointing out that A&A are merely question-begging. That is, rather than offering *neutral* criteria for demarcating the cognitive from the non-cognitive, they simply *presuppose* that cognition is *exclusively* a brain process. This clearly won't do, since it's exactly this conviction which is at stake. Inline with what I have said thus far, I take this to be a point well taken against A&A, which further shows the need to reexamine taken for granted assumptions.

In sum, regardless of the exact plausibility of A&A's proposal, it does however highlight the need for a non-anthropogenic, location-neutral, unbiased criteria for demarcating the cognitive from the non-cognitive. We suggested that, by demanding a MoC it makes it possible, and indeed a requirement, to promote a shift of focus away from boundaries towards the reexamination of the nature of cognition itself. We need to first account for *what* a cognitive process is, regardless of boundary issues.

Similarly, and this worry applies particularly to ascriptional demarcating criteria, a MoC becomes more pressing because everyone agrees that *we* are cognitive and that anything sufficiently *resembling us*, should also be counted as cognitive. What is not explained is what is it 'for us', let alone anything else, to be cognitive agents (Di Paolo 2009; Thompson 2007), We can stare at brains, biological bodies and external tools all day long, this will tell us *nothing* about cognitive agency.

We therefore appear to have some good reasons for demanding a MoC. The next section outlines a distinction which will serve as the basis for our alternative proposal in this work.

3 Embedding & Embodiment Revisited

To my mind, the EMH and SC more generally, are on the right track when emphasising embodiment-embedding in cognition. Yet, ultra cognitivists like A&A, need not take any issue with this. Therefore, we need to understand exactly *how* cognitive systems *are* embedded and embodied. To be all but trivial, it will not do to merely point this obvious fact out. So, in the next two subsections I will introduce a distinction between what I call *strong* and *weak* types of embedding & embodiment which will serve as two axis on which to plot an alternative MoC. This will be further articulated in the next two chapters.

3.1 - Weak & Strong Embedding

Brooks (1999) identifies *embedding* and *embodiment* as *the* two central concepts for a new understanding of cognition. Recall that the embedding thesis argues that cognition requires an environment, not only is it shaped by, but also crucially dependent upon, externally tools, processes and structures. Consequently, cognition cannot be effectively explained or studied, by examining processes, states, or structures that occur solely within the confines of the brain or body. Cognition is situated and unfolds in the context of a real-world environment.

With this in mind, I will argue that there are *two* very distinct ways that a system can be said to be embedded in an environment, not usually recognised in the SC literature (but see Sharkey & Ziemke 1998; Ziemke & Sharkey 2001; 2003; Ziemke 2001; 203). The distinction is drawn between what I will call *weak* and *strong embedding.* As a first approximation, to be *strongly embedded*, a system not only needs to be *in*, but needs to *have* an environment. In the sense I use this distinction *any* physical object extended in space can be said to be *in* an environment. This corresponds to the *coupling* (see Chapter 2) which obtains between system and environment, whereby a system is influenced by and in turn influences back, its environment.

A thermostat provides a good example of a system embedded *in,* but which does not *have* an environment. Such systems partake in (coupled) *dyadic* system-environment relationships and are what I call *weakly embedded* systems. However, some systems, primarily living, can also be said to *have* an environment in the sense that, this environment which it has, is a place of *intrinsic significance.*

I thus distinguish between two modes of embedding for any system. A system can either be weakly embedded, in which case it will be a *reactive* system that operates by external forces through dyadic causal relationships. Such systems, as we will further elaborate in the next chapter, lack the capacity to transform information into meaning. By contrast, any system can be said to be *strongly* embedded if and only if, it can *transform information* into meaning. I leave it to the next chapter to flesh this out. For now I merely introduce the distinction.

3.2 - Weak & Strong Embodiment

To understand the distinction between weak/strong embodiment, lets take a closer look at how the EMH treats the body. On the one hand, given the EMH functionalist underpinnings, cognitive systems do not strictly speaking need to be embodied, while on the other hand, embodiment is understood as a trivial taken for granted notion. Recall that functionalism asserts that computations are not tied down to any particular substrate. Although computations need some physical platform to be implemented they are *independent* of the platform.

Shapiro (2004) has dubbed this the "separability thesis" (ST). It states that a humanlike mind could perfectly well exist in a very non-humanlike body. Thus, although mind and body causally interact, the mind is in some sense autonomous from its morphological implementations and can thus be successfully abstracted away from these physical details. This, Shapiro claims, implies "body neutrality" whereby the kind of mind one has, is in no way determined by the characteristics of the body. The hardware/software distinction is thus upheld, but at a price. Since this seems to clearly imply a form of dualism, as a mind can now somehow float free from its body (Shapiro 2004; Thompson & Stapleton 2009).

Clark has been very explicit on how one should conceive of the body and in the process, committing himself to the ST. Accordingly, “the body, insofar as it is cognitively significant, turns out to be itself defined by a certain complex functional role” (Clark 2008b, p. 56). Furthermore, "the body is special. But we should understand its specialness through the familiar lens of our best information processing models of mind and cognition.” This notion of "embodiment" nicely integrates within the computational framework of cognitivism. It is in this sense, that the body can equally become a trivial taken for granted notion. Though cognitive systems need to have some kind of body, a physical implementation, the material bases of this implementation plays no *significant role* as such, *any* platform will do.

I call this type of embodiment - *weak embodiment.* Yes, the body matters, but *only as an implementation substrate*. The actual morphological structure of a particular system, nor the deeply integrated biological organisation of *living* bodies, play any essential role in cognitive processing. I leave it to Chapter 5 to explain strong embodiment.

Strong embedding-embodiment will be argued to form the basis of genuine cognition and constitutes two interconnect halves of a MoC.

Conclusion

This chapter argued that boundary disputes are unsolvable and made a case for a MoC, not as a means of settling boundaries disputes, but to avoid dualism and pursue non-cognitivism. An initial distinction between strong/weak embedding/embodiment was introduced which will serve as two axis for developing an alternative MoC.

Chapter Four
Strong Embedding

Introduction

In this chapter we begin our goal of developing a location-neutral, non-species-specific, non-cognitivist account of cognition. Drawing from the work of Jakob Von Uexküll, we sketch a framework on which the notion of strong embedding is based. We begin by proposing a biogenic methodology which is then complemented by Uexküll's work. We then go on to conceptualise the notion of strong embedding as the ability to transform information into meaning. We conclude the chapter by revisiting the EMH.

1 Of Strong Embedding

To provide a location-neutral, non-species-specific, non-cognitivist account of cognition, we first need to jettison the constraints of the anthropogenic thesis and endorse a biogenic stance. This will then be further developed around a Uexküllian framework.

1.1 - From Anthropogenic To a Biogenic Methodology

The primary aim of this section is to propose an alternative to the anthropogenic thesis which we saw limits the scope of cognition to human capacities. One of the underlying assumptions motivating this work, is that before cognitive systems can do the "higher-level" tasks (abstract reasoning, logic, planing, etc) found in humans, they first need to autonomously and effectively, negotiate their environment. All *living organisms* have capacities uniquely attuned to their particular environments enabling them to make a living. Insofar as this is the case, cognition must exist in *degrees* across the biological domain, and cannot be unique to humans.

This is not to devalue the higher-level capacities humans possess, only that, as we saw in the previous chapter, these by themselves cannot set the benchmark for a MoC. Notably, it is precisely the anthropogenic focus on high-level human cognitive capacities which has led to a systematic *neglect* and *devaluing*, of other "lower-order" capacities, which are equally important if not more so, for cognition. In so doing it has implicitly encouraged the assumption that, not only is there an *intrinsic* fact-of-the-matter distinction between "basic cognition" and "cognition proper", but also, that one *can* understand cognition *without* having to pay much attention to these so-called "basic forms" of cognition (Auletta 2011; Keijzer 2001). These anthropogenic preconceptions need to be rejected for a more biologically inclusive approach to cognition.

As the etymological origins of the word indicate, *bios* is the Greek for life and *genesis* meaning birth or origin. The *starting point* of a biogenic stance is that it attempts to understand cognition, first and foremost, as a *natural biological process,* in terms of biological functions like any other, which primarily contribute to the persistence, survival and general wellbeing of organisms. It recommends that *biological principles* (as appose to abstract functionalist ones) are our best guide into understanding *what* cognition is. Cognition is thus conceptualised as a *natural process,* rather than as an object (computer)[12] (Auletta 2011; Goodson 2003; Hoffmeyer 2008; Lyons 2006; Lyons & Keijzer 2007; Maturana & Varela 1980; Moreno et al 1997).

Because adaptations contributing to the viability and wellbeing of the organism tend to be conserved over evolutionary time, it advocates a strong *evolutionary continuity* among organisms of varying complexity. It recognises that complex life-forms and organic processes have evolved from simpler life-forms. A fairly uncontroversial point, but one with consequences that current cognitive science has not always appreciated.

High-level human activities are very late arrivals in the evolutionary scene. Indeed, all the abilities cognitivists take to be the hallmark of cognition; logic, mathematical reasoning, language etc, *presuppose* more basic system environment relations, which enable these late arrivals and, *which cannot be separated* from this basic core. Thus, rather than seeing simpler organism's actions as cognitively empty, they are best understood as a *fundamental prerequisite* which cannot be ignored. Moreover, it makes good methodological sense to start with simple cases then scale up, rather than as cognitivists do, start with the most complex (cf. Brooks 1999).

[12] Or a Watt-Governor for that matter (cf van Gelder 1995).

From this perspective, a clear unbiased line cannot be drawn between lower & higher levels of cognition, as cognition is on a *biological continuum.* This fits our discussion on boundaries rather well. Given the dynamic open nature of living system, which incessantly require energy from the environment, transforms it into usable fuel, discharge wastes and reproduce; they all also tend to share certain generic functions such as ingestion, digestion, circulation, respiration, replication etc. Thus while the heart of a leach for example, is neither homologous nor does it bear any structural resemblance to that of a human heart, both nevertheless serve the function of pumping blood in order to circulate oxygen and other nutrients and to remove waste. Only a commitment to anthropogenic intuitions prevents us from not understanding cognition in similar terms.

Anthropogenic approaches tend to neglect the entire evolutionary line that gives rise to "higher-level" cognitive abilities, making it difficult to understand their functional origins and how they relate to the whole organism. As Deacon (2012, p. 26) notes; "Minds were not in some way grafted onto biological systems; mentality emerged from and grew out of organisms during their evolution". Importantly, to take evolution seriously is to appreciate the *historical* nature of living organisms *as individuals* with their own *contingent* history which are not solely govern by deterministic laws (see Chapter 6, for further discussion).

Naturally human cognition itself falls under the purview of a biogenic stance and needs to be accounted for, but it *does not itself set the benchmark* for the cognitive. As such; "There is no assumption that human cognition is the "most developed" or "perfect" form of biological function, however extraordinary and complex it may be" (Lyons & Keijzer 2007, p. 141), as cognitivists tend to assume. If cognition evolved, as most would agree, then it is first and foremost a manner of basic *living* in the world.

Cognition, in all its forms, needs to be understood as grounded in biological principles of environmentally embedded organisms, which are geared towards viability. While the EMH starts from the "top", focusing on complex human cognitive skills, the biogenic approach starts from the "bottom", starting from biological facts which apply across the board, then works up to the more complex human cases. Thus the anthropogenic/

biogenic distinction is a *methodological* criteria for the study of cognition. It suggests a different *starting point,* that of natural biological organisms generally, rather than selective human capacities. As Lyons & Keijzer (ibid) point out;

> ...an investigator adopting an anthropogenic approach to cognition starts with the human case in the believe that the features of human cognition are the most plausible and potentially most fruitful (probably the only) guide to understanding the phenomena of cognition generally. By contrast, an investigator adopting a biological approach assumes that the principles of biological organisation present the most productive route to a general understanding of cognition because natural cognition is a biological process (ibid, pp. 138-139).

The biogenic approach is then a methodological principle for cognitive science, a starting point rather than a prescription on how to study cognition or *what* cognition is as such. It provides a foundation for developing an ontology of cognition.

In sum, cognition is not best conceived as an abstract disembodied phenomena modelled on selective human abilities. From the biogenic perspective, cognition is best understood in the general context of *biological* organisation/functioning. The starting point should be that of living organisms, from simple to complex. This allows for a much more inclusive, less chauvinistic, approach to cognition. Note however that an anthropogenic approach can itself be biological or include biological facts. For example facts from evolution or neuroscience but these do not provide the *foundation* for the ontology of cognition itself. These merely offer secondary constrains to be satisfied by an account grounded in human cognition (cf. Millikan 1984).

There is however a potential problem here. A common understanding of teleology (which for now assume is necessary for meaning and cognition) in biological sciences, is that purposiveness in organisms is simply an *ascription* of an observer. Intentionality, goal-directedness, meaning and value, is viewed as an illusion. Animal actions are *teleonomic*, the explanation of biological facts as the statistical results of natural selection which *post factum* gives the *appearance* of goal-direct behaviour (Dawkins, 1987). From this perspective, a teleological explanation can always be substituted by a (teleonomic) factual 'as-if' description (Deacon 2012; Nagel, 1977; Weber & Varela, 2002). To counter this sort of skepticism, we will in the next section draw from the work of Uexküll.

1.2 - The Emergent Umwelt

To elaborate on the tenets of the previous section I will draw on the work of theoretical biologist/ethologist Jakob von Uexküll. This will provide an alternative framework to help loosen the clutches of cognitivism.

I draw from Uexküll's work because it is biogenic, rejects anthropomorphism/ anthropogenic intuitions and endorses a view of organisms not as passive machine but as agent actively constructing a world. Moreover, agency is deeply biological and understood in *relational interactional* terms, rejecting the dualistic notion that subjects and objects are two distinct entities. And, it does so in true SC style, by emphasising the importance of embodiment and embedding.

A central concern for Uexküll was to introduce the notion of "agency" into biology, particularly in relation to meaning (Rüting 2004). Uexküll was very critical of the "mechanistic biology" of his day, which regarded organisms as machines, or as sensory and motor organs simply "stitched together". By contrast, Uexküll regarded organisms as more than the sum of their parts and argued that organisms are; "*subjects* whose essential activity consists of perceiving and acting" (Uexküll 1957. p, 6). Accordingly, biology should study organisms not as objects, but as *active subjects.*[13]

To illustrate how organisms, as agents, *meaningfully* act in their environments, Uexküll introduced the concept of an *Umwelt* around which he constructed his *theory of meaning.* This concept originated from Uexküll's close study of the relationship between organisms and their environments and recognising that each organism perceives and "constructs" its own unique individual subjective/phenomenal world. For Uexküll the perceived world of any organism *emerges* through the connection of what he called "receptor and effector cues". Giving rise to what we now might term, self-

[13] Throughout this and the following chapters I will use the terms "agent" and "subject" interchangeably assuming that they are roughly equivalent. We can provisionally understand an "agent" as any system which is goal directed (see Chapter 6). Here I prefer agent, as it seems to me to carry less anthropogenic baggage, and more easily applicable to other systems.

organising sensory and motor processes, coalescing into *sensorimotor loops*.[14] It is on the basis of deep dynamic action-perception integration, that organisms transform physical environments into *worlds of meaning.*

To appreciate the notion of an Umwelt, it will be helpful to contrast it with two other related, but distinct concepts (Emmeche 2001). These being the concept of a *habitat* and that of a *niche*. Very roughly, the habitat of an organism are those aspects of an organism's environment that are "objectively" specified by an *external observer.* While the niche of the organism, refers to its ecological functions within the ecosystem (Odling-Smee 2003). Thus, although related, they are evidently distinct. The concept of an Umwelt highlights that, not only do organisms actively contribute to the construction of its own world, but also that the world is infused with unique *meaning* and signification *for the organism*, characteristics not recognised by the other concepts.

An Umwelt then, is "the self-centred world of the organism - the world in which an organism lives, the one that it recognises and makes" (Kull 2010, p. 43). More specifically, it refers to the *phenomenal* side of the organism, the world *around* an organism as it is *perceived* and subjectively *experienced* by the organism, those aspects of its world which have unique salient for it. A unique world the organism actively creates. These phenomenally salient aspects are a result of the organism's species-specific sense-organs, its morphological structural organisation its biological needs, currant state and its ongoing worldly activities.

Uexküll presents a picture of organisms, not as discrete predefined static bounded units, but as contingently ongoing, dynamically unfolding, interactive, *relational active processes*. Uexküll places much emphasis on the intertwined *reciprocal* nature of this relationship. Organisms and environment form *single integrated coupled systems* of mutual specification and as such, subject and object cannot be viewed as two separate entities as they are mutually, though asymmetrically, interdependent (see Chapter 6). The traditional inside/outside dichotomy prominent in the EMH, simply falls away here, an organism is nothing without its Umwelt, and an Umwelt does not exist without an

[14] Although, as we will soon see, these are somewhat different from sensorimotor loops.

organism. The Umwelt is therefore a thoroughly *relational process;* it is nor something *in* the organism nor *outside* independent of it. It is not something which *can* exist independently of the organism but nor is it strictly inside the organism, it is precisely that which emerges in the middle so to speak.

1.2.1 - Functional Cycles

This inextricableness between organism and environment finds expression in Uexküll's concept of "functional cycles", which serves as the mechanism for *Umwelt-construction*. These are the abstract structures that tie together the organisms's subjective experience, its perception (the *perceptual cue*) and the manifested behaviour of the agent (the *effector cue*). This led Uexküll (2010) to infer that different species of organisms, would engage in various functional relationships with the same environment, yet experience it in different ways. Organisms could have the *same environment* but *different Umwelt*. Uexküll takes the observation that organisms respond only to very specific information while selectively ignoring other, as evidence for this conclusion. Accordingly, organisms equipped with their species-specific sense-organs have different functional cycles which enables them to selectively respond to relevant information cues which will lead to unique species-relative constructed worlds.

For Uexküll, purposeful goal-directed behaviour, can only be adequately explained by uniting the organism's subjective "perceptual world" and its "effector" enacted world, into a single closed *whole*.

> We can no longer regard animals as mere machines, but as subjects whose essential activity consists in perceiving and acting.... All that a subject perceives becomes his perceptual world and all that he does, his effector world. Perceptual and effector worlds together form a closed unit, the Umwelt (ibid, 6)

Here *agency* acts as an *integrative mechanism* for agent-environment coherence, the organism's subjective nature integrates its components into a purposeful goal-directed whole. This is in sharp contrast to the purely mechanistic doctrine that all living beings are "mere machines".

The notion of *circularity* is crucial here as it links perception to action and turns a closed sensorimotor loop, into a continuous meaningful process of interaction. Every perception requires a readiness to act, an ability to choose some phenomena which had been neutral up to that point, while every actions in turn requires perception. Without perception there is no action and without action no perception. In this manner organism and environment *co-evolve* in mutual specifying circular processes of dynamic feedback. The organism acts in the environment and the environment *feeds-back* into the organism, in the process transforming this environment into an Umwelt. The notion of the co-evolution of organism and environment, is fundamental for our understanding of cognition, and presents further support for overcoming the individualism of the inner/outer dichotomy.

Unlike a sensorimotor loop however, which *can* be examined in isolation from the behaviour of the organism as a whole, a functional cycle can only be examined in *context with the behaviour of the embodied organism*. The sensorimotor loop involved in moving away from a light source for example, cannot be described as a functional cycle by itself (Macinnes & Di Paolo 2006). This is because, only when we place the sensorimotor process *in context,* with the light, and hence the perceptual cue, diminishing as the organism moves away, can we describe this behaviour as a functional cycle. Importantly, the perceptual cue cannot be said to exist in any particular location within the parts the organism. Their existence can only be inferred because we are assuming the existence of functional cycles (Almeida e Costa et al. 2008; Macinnes & Di Paolo 2005).

This point has an important consequence, it seems to suggest that embodied sensorimotor activity which recursively interlocks action and perception, so that action provides guidance for perception and perception guides action, *cannot* be considered the *sole* source of meaning and cognition. Effector and receptor tools (action and perception) alone, as Uexküll claimed, are insufficient to make up motivated meaningful animal behaviour, something more appears to be needed (Di Paolo 2003; Moreno & Etxeberria, 2005).

We can see this by considering the relation between organism and relevant informational "stimuli" again. Do organisms merely passively react to external forces as cogs in machines? For Uexküll this is self-evidently no, and this can be seen by looking at organismic *embodiment.* In order to understand why animals are morphologically/ structurally organised in the way they are, and thus why they act on and perfectly fit into the world as they do, Uexküll insists that: "meaning is the guiding star that biology must follow". But what does this almost mystical remark mean?

The intuition here, as we have already seen, is that organisms are *agents* not passive entities at the mercy of external forces, out of vital necessity, they *need* to be active creators of their own Umwelt. Only in so doing can they become an integral part of Nature's grand design. Appreciating this point should help appreciate that there is more to cognition than mere sensorimotor coupling. (This will be further discussed in the next chapters.)

Consider Uexküll's (2010) example of a flower in a blooming meadow, which comes to find itself in the Umwelt of a little girl, an ant, a cicada larva and a cow. Depending on the Umwelt stage in which it appears, the flower stem plays the role of ornament for the little girl, a path for the ant, liquid extraction point for cicada-larva (which will use it to build its house) and food for the cow. Each component of the flower stem-object comes into contact with a matching "complement" of the agents body which becomes the "meaning-utiliser". Thus the Umwelt, due in great part to the *morphology* of the agent, becomes its personal system of meaning,

Consequently, there can be no neutral objects for living organisms. Meanings are "imprinted" by agents upon otherwise meaningless objects. Objects without any role in relation to a particular Umwelt simply do not exist for the organism involved. Furthermore, in different Umwelten the same object may constitute a different reality and thus have, what Uexküll called different "functional tones".[15] A chair for a human is something to sit on while for a dog its something to lie under.

[15] These are very similar to what Gibson (1979) called "affordances", only, they are not invariant objective properties of the world, but emerge in context and are relative to the organism.

As we saw, there is a continuous reciprocal relation between world-experience and organism. The organs of the ant are in tune with the demands and tasks within its Umwelt, while at the same time its Umwelt is created through the capacities and actualities of its sense-organs. Morphology, interests, needs and capacities give rise to a certain Umwelt, and the Umwelt refers to and demands certain capacities and interests.

Consider the female tic: A female tick's skin is sensitive to light and this guides her up from the ground to a brighter position on a branch or blade of grass. Once up, she will hang there until butyric acid emanating from a mammal reaches her. Upon sensing the butyric acid, she will drop and plunge straight into the mammal. Here the perceptual cue of butyric acid triggers an effector cue which results in the release of the tick's legs and enables it to drop onto the mammal. When the tactile cue of hitting the mammal's coat is triggered, she begins to move around, searching for warmth, upon encountering the skin she will trigger a burrowing behaviour, after which she starts to burrow in and suck the warm nourishing blood. When she has finished her first and last meal, she will drop down, lay her eggs on the earth, and die.

As Uexküll points out, practically everything in the world which engulfs the tick, has absolutely no salient value or meaning for it. The stars, weather, noises, smells, leaves, shadows, and so on, do not matter to her. Certainly they will belong to the Umwelten of other organisms living amidst the tick, but they do not "carry" any meaning for our female tick. None of these are salient or convey any meaningful information *for* the tic itself, its Umwelt consists merely of three information bearing cues, which are of intrinsically significance. This theory of meaning then, helps Uexküll explain all animal behaviour, the behavioural unity of organisms and their environmental embedding, in a non-anthropomorphic biologically grounded manner

The above examples suggest that organisms can autonomously decide which information to react to, so a stimulus does not necessarily lead to the formation of a functional cycle. This means that to some extent organisms can choose what will serve as a perceptual cue under different contextual conditions or different internal states and so choose what they will experience. Thus, when the tick was on the branch, the smell of butyric acid acted as a perceptual cue, but when the tick was in the fur, this was no longer the case.

This clearly suggests that, *information* is situated and context-dependent, even for a tic. A topic to which we now turn.

2 Strong Embedding as the Transformation of Information Into Meaning

Uexküll's work was introduced as a framework for explaining the notion of strong embedding, which can *provisionally* be conceptualised as the capacity for *transforming information into meaning through functional cycles.* However, given the multiple meanings the concepts of information and meaning have, we will have to refine them in light of our current discussion.

2.1 - Information and Meaning

From the perspective of information theory developed by Wiener & Shannon, information was defined in terms of the probability of transmission of a digital string of symbols through a channel (Shannon 1948). Understood this way, information could be mathematically defined, measured and stored, this implied that it was context independent, universal and devoid of meaning. However, not everyone agreed with this view. Bateson (1979) for example, wanted to get *meaning* back into information. These theorists argued that, context should be taken into account, and that information needs to be treated as something situated. Because situatedness implied that universalisation and quantification becomes practically impossible, information lost its meaning and Shannon's information theory won the day (cf. Deacon 2007; 2008).

Information thus lost its "body", and its meaning too. In the process a distinction between matter and form was introduced which is structurally similar to mind-body dualism (Brier 2010; Hayles 1999; Oyama 2000; Thompson 2007). This is obviously problematic for the sort of view we are attempting to develop. Therefore, in the context of the Uexküllian framework, the concept of *meaning* will be argued to be more relevant than the concept of information (as traditionally understood), when it comes to understanding bio-systems. To help us put meaning back into information, it will be useful to firstly revive its original understanding, which had to do with *form,* "to inform" means "to put form into" something or other. This original notion of information will guide subsequent understanding.[16]

With these preliminaries in mind, our point of departure will be the idea that cognitive systems do not traffic in abstract form-independent information, but in *meaning*. Thus, information has to be understood in relation to meaning not in terms of standard information theory, which reduces communication to a *dyadic covariance* (cause-and-effect) process of ‘signal and response', a transfer of information between sender and receiver (Bates, 2006; Dretske 1981; Skyrms 2010). Nor about logical truth conditions, i.e. what the world would have to be like for a sentence to be “true”, nor about mapping from a logical formula to some constructed world, model, or other formal object. Rather, to understand information and its relation to meaning, we will follow Bateson (1972, p. 315), who characterises the most basic "unit" of information as a "*difference that makes a difference"*. For, implicit in this definition, is the idea that it is the *meaning* of the information which makes *the* difference.

Because the notion of meaning will be developed in the Chapter 6, it will suffice here to understand it as coextensive with the concept of an Umwelt. In the sense that, as with the Umwelt, meaning is also a *relational* concept and that all living systems constitute their identity whilst constructing meaning by continuously responding to the environment in accordance with their unique boundary structure. Thus, meaning is fundamentally an active dynamic process, the result of the system's functional cycles. Importantly, and this is partly why we used the work of Uexküll, meaning is not only a mode of human symbolic thought, restricted to conceptual/propositional knowledge.

It is through functional cycles that organisms *transform information into meaning*. To see more precisely what I mean by this, consider Kant's statement, that "in a piece of chalk there are an infinite number of potential facts", used by Bateson (1972) to illustrate the idea that a potential fact only becomes an *actual* fact, when this is perceived as *relevant* to a system. It is in this way that a difference comes to make a

[16] The aim here is not to provide a "theory" of information, but simply to provide a different means of approaching the concept, one congenial to our general approach in this work, and further refined in Chapter 6.

difference and information becomes *meaning*. Bateson's conceptualisation of information implies that information does not exist in isolation, but only in *relation* to a particular organism. There needs to be *some system* for whom information *can* make a difference, a system capable of transforming information into meaning. Information then, contrary to Shannon and cognitivism, cannot be a disembodied invariant.

Information is embodied or informed, context-dependent and agent-relative even for the most simple of living organisms. As Oyama (2000, p.147) notes, information; "grows out of kinds of relations". Indeed, from the work of Uexküll we learn how a given environmental feature carries or generates different information for different organisms and even for the same organism in different states and at different times. When a bird bursts into song, the sounds that reach our ears inform us that there must be a bird nearby, but for a moth, no information is generated. And if you were an expert on birdsong, you might identify it as a certain species of bird, while a child would simply call it 'bird'. Therefore, from the same sound, different information is produced.

As the example demonstrates, information depends on the interplay between context, history and the current state of the organism - an *agent* - for whom it is meaningful information. This suggests two important points; (1) information and meaning are *not* two different things and (2), information is information only *for* an agent that finds it meaningful. *There is no information independent of an agent.*

Anticipating the work of Chapter 6, what these two points together suggest, is that organisms are *interpretive agents*, not just passive receivers of signals, nor the sort of systems which picks-up observer-independent information. Indeed, with regards to living organisms, this is simply a cognitivist fiction. Ultimately, interpretation implies the ability to transform, or recognise, signals (information) into *signs* by giving meaning to them. This presents us with the three basic elements of semiosis: object, interpreter and sign (Uexküll 1992). For now it is sufficient to note that, from the Uexküllian perspective developed here, living organisms are interpreters of the world, not pre-programmed machines.

In sum, the ability to find the world *intrinsically meaningful*, vis-à-vis transforming information into meaning, is what I call *strong embedding*. A biological ability not exclusively human nor symbolic or linguistic in scope. Through dynamic functional cycles, the system's actions alter its Umwelt as it experiences it. While in turn, these alterations modulate the system's behaviour and the development of its functional cycles, which go on to alter the Umwelt in a continuously dynamic and ongoing way. The system's distinctive sensorimotor capacities enable it to act and this action alters and transforms the types of information available for the organism to use.

Finally, "transforming information" should *not* be confused with "picking up" or "extracting" information, as if it is already present "out there" before the appearance of any organism. Trans*forming* information into meaning should be understood as a *formative process* rather than a formal one. Although information is transformed into meaning, it is not something done "in the head". We can say that it requires a "basic mind" but it is not *in* the mind. That is, information, although dependent on an agent, is not dependent on a "mind" (in the sense of a fully fledged proposition-using conscious human mind) as such. Exactly how such systems become capable of such feats will be explored in the following two chapters.

2.2 - The EMH and Strong/Weak Embedding

Armed with these preliminaries on information and meaning I now want to further illustrate the distinction between strong/weak embedding by connecting it to the EMH. I want to show that extended cognitive systems (ECS), as defended by the EMH, fall under the class of *weakly* embedded systems. Certainly ECS's are embedded *in* and tightly coupled with, their environment, but, they do not *have* a world. Moreover, from our discussion on the EMH, it appears that it does not have the theoretical resources to account for strong embedding either Recall that C&C argued for ECS's by pointing to how an agent forms a "coupled system" with selective external resources. But is this coupling sufficient to regard ECS as strongly embedded?

At first glance the EMH might appear deceptively similar to the view presented above. But I think it is not and this can be demonstrated by noting that the EMH has no place for the *agent*. As such, the cognitive "agent" in the EMH is merely a reactive "machine" that does not seem to deserve the status of agent. Organism-environment coupling, as advocated by the EMH, is *dyadic* and reductive. This is because, the *agent* is not adequately addressed in these relations. The EMH theorists are certainly correct to draw our attention to the way various external recourses can be included as components in a cognitive task. However, they do so by virtue of the *meaning* and *significance* these have for us as *agents,* in the particular cultural embedding we find ourselves in.

Agency, as Uexküll saw, serves to integrated the various components of the system into a purposefully goal-directed whole, without out agency, there is only a mechanical closed sensorimotor loop. Performing a mathematical problem with pen and paper aids my task of calculation, but, it does so by virtue of the meaning this particular task has *for me* and the various cultural possibilities that it affords me. Were this not the case, this task would not get off the ground.

Essentially, the dyadic nature of dynamical, embodied, situated and extended sensorimotor loops, is *not enough* to turn *raw "information" into meaning*. Although sensorimotor motor integration is crucial and necessary, it is by itself, not sufficient to generate meaning (Jonas 2001; Froese & Ziemke 2009). An *agent*, rather than mere organism or machine, is also required. The difference here can be subtle but nonetheless very important.

Thus imagine a jigsaw building robot - Jigro - that builds jigsaws by relying not only on internal computational resources, but also by using its morphology and the ability to physically manipulate the pieces. Now, regardless of its computational architecture and its physical morphology, Jigro merely responds/reacts *mechanically* to fixed (meaningless) features of the environment and not to context or anything which has any *significance* for him. He is thus *not capable* of transforming information into meaning. There is *no* information *for* Jigro, he is simply pushed around by physical forces.

By contrast, if you did the puzzle, it would have inherent meaning for you. Unlike Jigro, environmental features do not just affect you in a brute causal manner, as mere "raw" information impinging on your sense organs. Rather, because you can transform information into meaning, they do so by virtue of the *meaning* and *significance* they *intrinsically* have for you. An ECS is in exactly the same situation as Jigro, so, clearly something remains missing from the EMH. This also highlight the difficulty with ascriptional demarcation criteria of cognition, there is more to cognition then mere functional organisation or surface behaviour.

Although Uexküll provided a *framework* where agency takes centre stage, it remains crucially underdeveloped and open to scepticism. Someone might insist that this is all ascriptional and not intrinsic to the systems itself.[17] Simple organism like tics are merely mechanical automata not agents. It is not entirely clear that Uexküll has the theoretical resources to deal with these issues. The question now is; can we further ground this basic account of agency on principles which can deal with these worries? A response lies in the complimentary notion of strong embodiment. This we explore in the next chapter.

Conclusion

As a means of developing an alternative non-cognitivist MoC we drew on several sources to developed the distinction between strong/weak embedding. We presented the notion of strong embedding as a capacity to transform information into meaning.

[17] Brier (2008b, p. 30) argues that Uexküll's "framework is behavioural and functionalist like cybernetics". Although I think this is a mistake I read this as a prompt to strength this Uexküllian framework.

Chapter Five
Strong Embodiment

Introduction

In the previous chapter we argued that the essence of strong embedding lies in the ability agents have for finding the world inherently meaningful. The question now is; what does it take to be such an agent? The answer presented here is strong embodiment, understood in terms of autonomy based on autopiesis and recursive self-maintenance. This will serve to enrich our initial account of agency and avoid the worries flagged at the end of the previous chapter.

1 Of Strong Embodiment

Here an account of autonomy will be developed which is argued to be the basis of strong embodiment. The class of system identified as strongly embedded, are only so as a consequence of being *strongly embodied*. Essentially, the one implies and entails the other.

1.1 - Autopoisies

Cognition requires embodiment but embodiment of a kind which can account for the deeply integrated nature of organisms envisioned by Uexküll; for how an organism's subjective nature can integrate its components into a purposeful goal-directed whole. We thus need an account which can ground, not only the notion of agency introduced in the previous chapter, but the idea that this agency acts as an integrative mechanism for agent-environment coherence and enables the transforming of information into meaning. The answer offered here is *autonomy* (Bickhard 2004; 2009; Collier, 2002; Christensen, 2000; Christensen & Bickhard 2002; Di Paolo, 2003; Emmeche, 2004; Hooker 2009; Rosen 1991; Thompson, 2007; Varela, 1997; Ziemke 2007; Ziemke & Sharkey, 2001).

The concept of autonomy has a long and varied history. In ancient Greece it was mostly applied to city-states and related to the political right for self-governance. In modem philosophy, the concept is used mostly in relation to the self-determination of persons with regards to political and ethical matters. In cognitive science, particularly robotics, the term is mostly used in connection with embodiment-embedding and the ability of machines to achieve certain tasks with minimal human intervention (Froese et al. 2007) The notion of autonomy of interest here is a biologically inspired one, grounded on autopiesis and recursive self-maintenance (Bickhard 2008; Kauffman 2000; Moreno et al. 2008; Varela 1997).

This autonomy however, does not mean systems are isolated or independent from the environment, but rather, that they can *act on their own behalf* and thereby can self-define and construct its own identity according to its own laws (Kauffman & Clayton 2006). It is this particular idea of autonomy which we will align with embodiment and grounds what I term *strong embodiment* (cf. Ziemke 2007). We can thus identify two essential properties of strongly embodied/autonomous systems, *self-production* and *self-governance*. By contrast, *heteronomous systems,* are a class of system that are other-governed or, governed from the *outside,* subject to external control. We begin with autopiesis.

Continuing in the same theoretical tradition as Uexküll, the theoretical biologists Humberto Maturana and Francisco Varela (1980; 1989) regard the essential difference between living organisms and machines as primarily one of autonomous self-construction. Maturana & Varela's starting point is a question concerning the type of organisation necessary for life itself. To answer this question, they introduced the concept of *autopoiesis* (from the Greek for self-producing) which highlights the *self-producing dynamics* of living systems and makes *autonomy* essential to life.   Like Uexküll, for Maturana & Varela, living is an *active process* of deeply integrated autonomous organisms, not any of their parts.

Autonomous agency is defined in terms of a self-producing network of processes which constitute its own identity. Autopoiesis, is then an *abstract formalisation* of a special class of CAS;[18] a *self-creating system*. More precisely, autopietic systems are specified as self-maintaining/self-producing networks of relations, whereby the activity of the system consists in a continuous and recursive re-generation/construction of the

[18] Complex adaptive system.

processes and components, including a boundary, which together constitute the system as an integrated distinct unit, in the face of internal and external perturbations (Luisi 2006; Lyons 2004; Maturana & Varela 1980; Varela 1997; Thompson 2007). Varela (1997) defines an autopoietic system as follows;

> An autopoietic system is organised (defined as a unity) as a network of processes of production (synthesis and destruction) of components such that these components (i) continuously regenerate and realize the network that produces them, and (ii) constitute the system as a distinguishable unity in the domain they exist (p. 75)

Living cells and organisms are prime examples of autopoietic systems. These possess the properties of *self-maintenance* by virtue of actively maintaining its own integral organisation and *self-production* by virtue of actively producing its own components. Furthermore, the network of processes is enclosed in a self-constructed semipermeable membrane individuating it from its surrounding medium. Such systems are *operationally closed*, meaning that every constituent process of the system is conditioned by and dependent upon, some other process in the system. In order for a process to be included as a part of the system, it must enable and be enabled by, at least one other process of that system in a circular causal fashion.

Autopoiesis thus attempts to provide a theoretically fruitful and scientifically plausible, account of the *biological organisation* which grounds the origin of life and the *autonomy* of living systems. Like Uexküll, it aims to provide an *wholistic* framework for understanding organisms not merely as a set of disparate mechanistic components thrown together, but as fully integrated units which are *agents* in their own right. Moreover, it also seems to provide the potential foundation for explaining how this type of biological autonomy, grounds the emergence of an organism's natural Umwelt. Autopiesis, it is argued, can help us understand *from the inside*, the *purposeful* nature of the living.

Now, although autopoiesis is a good starting point for a theory of autonomy, and necessary for autonomous agency, it is in some respects inadequate for our purpose, particularly to ground strong embodiment. As noted above, the theory provides an abstract formalism of an autonomous network, as such, these networks are not considered in terms of *material* structures as such. Rather, they are conceived exclusively as *functional* networks. To put it slightly differently, the theory tended to mostly focus on form rather than structure or matter (Collier 2002; Froese & Steward 2010). As a consequence, *living,* as a *biological process,* was conceived in mostly abstract terms and overlooked, what Di Paolo (2009) calls, its intrinsically "precarious nature".

Because autopiesis is an all-or-nothing class category, it leaves no conceptual room for explaining gradation of concern and interest by the living and is thus incapable of grounding Uexküll account of agency and meaning or embodiment. Essentially, given its abstract nature, the concrete *thermodynamical requirements* of the system have been neglected (Barandiaran 2004; Capra 1997; Christensen & Bickhard 2002; Christensen & Hooker 2002; Collier 2002; Froese & Steward 2010; Kauffman 2000; 2003; Barandairan & Moreno 2008).

Therefore, as well as the formal organisational self-producing/self-sustaining properties (the operational/constructive closure), we also need to take into account the energetic thermodynamic (structural/material) requirements of CAS. We need to account for the neglected thermodynamic requirements, the *essential materiality* and hence the *strong embodiment*, of living systems. Self-organising dissipative systems, which are types of CAS, offer a good complementary account.

1.2 - Types of Order; Crystals & Candle-flames

The universe is awash with organised and disorganised material processes of various kinds. A cursory look at these material processes reveal that they come in various forms and degrees. Some, such as crystals and rocks, display a high level of *cohesive order*. Intensive force from outside is needed to disrupt this structural cohesion. At the other extreme, other processes exhibit no cohesive order whatsoever, as with gases. So cohesion can be understood as that property which endows different types of systems with a distinctive type of *unity,* providing varying degrees of stability in the face of internal and external perturbations (Campbell 2010; Collier 1988, 1999).

Orderly systems can be divided into two broad classes relative to their cohesion. The first class are characterised by their strong cohesion and constitute conservative (energetically speaking) static structure. These structures have strong internal cohesive bonds which are not easily disrupted. The cohesive bonds produces the system's global integrity and thereby individuate it from its environment. They are a product of the intrinsic nature of a set of components interacting under certain specific internal/ external conditions. Due to the energetically conservative nature of these processes, once created, they will exist indefinitely. Common examples of these types of structures are rocks and crystals.

A second class of system - CAS - exhibit weaker internal cohesion and its components are organised in such a manner as to form "dissipative structures" (Prigogine & Stenghers 1984). These system are complex, dynamically open and far from-thermodynamic-equilibrium. Here order, referred to as *dissipative* order, forms into dissipative structures and is rather different from the first class. The term dissipative structure was introduced by Prigogine (1977; 1996) to characterise a certain kind of *emergent* order/organisation comprised by a set of nonlinear interacting elements which generate a cohesive dynamic pattern in far-from-equilibrium conditions and which ceases to exist if these conditions are not maintained.

For Prigogine, dissipative structures are types of far-from-equilibrium *self-organising* systems that are "open" to sources of energy-matter which it uses then expels (dissipate) in the form of waste products, back into the environment. Recall that self-organisation refers to a system's transition from a disordered into an orderly state, through the interaction of local components, in the absence of external or centralised control. Through processes of self-organisation global emergent structure/patters appear without the need of explicit dictation from outside the system. Constraints on form and structure are internal to the system and result solely from the *interactions between its subcomponents*. These patterns of self-organised emergent order may be found in very different processes and across different levels of spatiotemporal scale (Camazine et al. 2000). Prigogine's insight was that when such self-organising open systems get into stationary states, they often organise themselves in ways that promote stability and order.

To produce these sorts of structures a system must exhibit some nonlinear properties and possess some positive or negative feedback mechanisms. It also requires a constant steady flow of matter-energy to maintain it far-from-equilibrium and stable. A common example is the Rayleigh-Bernard convection cells, where regular patterns of convection cells form on the surface of a fluid maintained under appropriate heat differential between its bottom and its open surface (Strogatz, 1994). Here the maintenance of the heat differential is dependent on an external source of energy (the boundary conditions), a fire. Though the system can maintain a certain degree of stability, it is however *completely* at the mercy of the boundary conditions that help maintain it, which if altered, leads to its collapse.

Some dissipative systems however, are also capable of regenerating some of the conditions for the process to occur, these are called "*self-maintaining systems*" (Bickhard 2009; Christensen & Hooker 2002). The property of self-maintenance refers to a particular causal regime, whereby a system is capable of exerting a causal influence on *some* of the boundary conditions which enable its own persistence. A candle flame is a good example of such a system. It can maintain above combustion threshold temperatures, in a standard gravitational field and atmosphere, it induces convections which draw in oxygen and eliminates combustion products and it vaporises wax into useable fuel. (Bickhard 2009; Barandiaran & Moreno 2008; Collier 1999; Hooker 2011). These systems are ubiquitous in nature and range from burning candles to living organisms.

All self-maintaining systems possess a type of *organisation* which enables then to persist and maintain a constant stable state at a distance from thermodynamic equilibrium despite ongoing and irreversible processes of construction and degeneration. The far-from-equilibrium conditions are kept stable, by virtue of the establishment of certain internal organisational dynamics and certain external boundary conditions, They are capable, unlike the Rayleigh-Bernard convections, of *contributing to their own self-maintenance.* For these reasons, self-organising self-maintaining far-from-equilibrium dissipative systems, present us with a bridge between the abstract form of autopiesis and the *essential materiality* of concrete physical structures.

However, all CAS are self-maintaining dissipative structures (Kauffman 2011), does this imply there is no difference between organisms and a candle flames? As Hutto (2010, p. 45) recently puts it; "what is that makes self-organising sophisticated biological organisms importantly *unlike* other kinds of purely physical systems". Since living systems are instances of CAS, what is it that *does* make them different, if not in kind then at least in degree, from other systems in this broader class (Capra 1997)? Linking autopiesis with self-maintenance provides an answer.

1.3 - Dissipative Structures to Autonomous Systems

As Schrödinger (1944) famously noted, all living systems exist in states far-from-thermodynamic-equilibrium, and it is thus puzzling that they can retain stability for periods of time without disintegrating through entropy (second law of thermodynamics). Indeed, most dissipative structures eventually succumb to this particular fate. Recall that according to the second law of thermodynamics, energy and material in an *isolated closed system*, will become randomly distributed over time and eventually reach a state of equilibrium (Mitchell 2009). That is, *entropy* will steadily increase and lead the system to lose all its ability to do work. Schrödinger's own insightful suggestion to the puzzle, anticipating Prigogine by some decades, was to point to systemic *organisation.*

Schrödinger noted that, while it *seems* that living systems disobey the second law, this is not in actual fact accurate. Rather, the second law, as originally formulated, does *not* apply to *open* systems, only to *closed* isolated systems. Open systems, unlike closed ones, are able to consume and exchange energy with the environment to keep going and maintain stability. According to Schrödinger, because of this openness, living systems are organised to *act,* to *do something*; to live, to reproduce, to strive for survival. they exhibit *recursive* self-maintenance or, *adaptivity*. Ultimately, living systems are organised to avoid thermodynamic equilibrium and strive for *self-preservation* (Bickhard 2004; Capra 1997; Collier 2000; Schneider & Sagan, 2005).

As open systems with certain organisational features, living embodied organisms can resist entropy by *actively* importing "order" via energy-material exchange, from their environments into themselves. Embodied self-constructed mechanisms, primarily in the form of metabolic processes can then chemically transform these into useable fuel for the synthesis of biological important molecules. "Disorder" is then exported in the form of waste products. These far-from-equilibrium processes require *continuous recursive adaptive interactions* and transactions with the environment, in order to maintain the far-from-equilibrium conditions and cohesive identity.

This adaptive recursive interaction is in aid of guiding energy into the dynamic organisational processes constituting the system. This in turn serves to improve cohesive integration of systemic processes and the subsequently better coordination and adaptivity for diverse system needs and interactive possibilities. This provides the system with a double circular (constructive/interactive) self-referential loop: act to maintain cohesion and maintain and improve cohesion by acting.

Bringing our autopietic and thermodynamic considerations together shows us that autonomy involves *four* central requirements. Firstly, a relatively stable persisting processes, or system. Such a system needs to have some degree of cohesion (not too strong but also not to weak either) in order to be sufficiently stable so as to be a potential locus of autonomy. It therefore "stands-out" from its medium as a distinct entity in its own right just like rocks and crystals but unlike gases.

Secondly, unlike rocks and crystals, it requires a certain embodied (self-creating) *intrinsic internal dynamics*, a recursive circular cohesive organisation, which requires that it is constantly self-monitoring, self-maintaining and self-regenerating/self-repairing, so as to offset deterioration and decay and be capable of reconstructing/ repairing its own components.

Thirdly, in order for the system to evolve and develop in any significant manner, it requires a *interactive/external dynamic loop*, which enables it to actively seek out relevant resources by altering its self-maintaining methods and boundary conditions. It can adaptively transform its boundary conditions to ensure the required flow of matter and energy for functional integration and systemic cohesiveness. It needs to act on its own behalf.

Finally, it needs to produce its own *semipermeable membrane* which individuates it as the system it is. Only by endogenously constructing a physical boundary, can the organisation of the system, the network of relations which constitute it as a distinct unity, be differentiated from its environment. It is through the introduction of this membrane that a distinct inner medium is created. However, as already argued in Chapter 3, these are not fixed or static. Consequently, systems which meet these four requirement, are also *strongly embodied*.

It is this particular type of embodied self-producing/self-maintaining system, capable of acting on its own behalf, which we shall call *autonomous*. Following Bickhard we can say that autonomy, by contrast with merely self-maintaining dissipative structures, is an embodied process of *recursive self-maintenance* (Bickhard, 2004, p. 24). Autonomous system are capable of altering their methods of self-maintenance and are able to adjust responses flexibly to meet changing needs and opportunities on their own accord.

Conclusion

We argued that biological autonomy is a dual process of embodied self-construction and thermodynamic interaction. This differs from simple CAS, which can only maintain their organisation under a very restricted set of external conditions which it cannot alter; and more complex self-maintaining systems, such as candle flames which do work to maintain the conditions that enable persistence, but cannot actively alter all its boundary conditions, it cannot actively seek out resources for self-maintenance, nor regenerate new components. It cannot create more wax or move if oxygen supplies run low, but if it did, it would be autonomous.

Chapter Six
Bio-Semiotic Cognition

Introduction

This chapter brings the various strands of this work together; I argue that strong embodiment provides us with a biological grounding for the integrated nature of organisms as intrinsically goal-directed purposeful agents in their own right as Uexküll argued. We organise our discussion around four basic features which together are argued to constitute a bio-semiotic agency with the first signs of cognition. We conclude by suggesting that the ability to read signs is the distinctive feature of cognition.

1 Autonomy to Agency

How do we get from autonomy to bonafide cognitive agency? In the next few subsections we will present an account.

1.1 - Relational Being

What exactly is an *agent* so that it can exhibit agency and basic forms of cognition? In order to connect the Uexküllian framework (which served as the basis of strong embedding) with the ideas on strong embodiment, and illustrate how together they constitute a basic MoC, I will frame my discussion around a recent proposal for minimal agency by Barandiaran et al (2009). To this proposal I add a further requirement, which I will argue constitutes the minimal basis not only for agency, but *basic cognition* too.[19]

Barandiaran et al (2009) identify *three* features required for minimal agency (see also, Di Paolo 2005; Barandiaran & Moreno 2008; Skewes & Hooker 2009). Firstly, agency requires a (self-producing) system which is a *distinguishable entity* from its surrounding

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[19] This and the previous chapter, in varying degrees, draws heavily from three primary sources; autopiesis, biosemiotics and the theory of recursively self-maintenance. It is an underlying assumption here that certain aspects of all three theories can mutually compliment each other. Here I take some steps towards showing that self-maintaining systems can enrich autopoiesis as it places great emphasis on the thermodynamic active requirement of material systems. While, biosemiotics can enrich both these views by showing how such systems use and require signs (which are rooted in the world) in order to maintain viability. However, Bickhard (who introduced the theory of self-maintaining systems) developed his account in order to provide a naturalist account of representations, his conclusion is *not* advocated. The synthesis presented here is aimed to be thoroughly non-representationalists.

medium. Secondly, this system needs to be capable of *doing something by itself* and enter into an *asymmetrical* relationship with its environment. Thirdly, the system does so according to goals or norms which are *intrinsically its own.* To these I add a further requirement: that in order to be a fully *cognitive* agent, the system needs to be capable of *reading signs*. Systems fulfilling all *four* requirements will be argued to be genuine cognitive systems and bear a MoC.

In the previous chapter an *autonomous* systems was identified as a far-from-thermodynamic-equilibrium open, recursively self-maintaining, self-producing network of processes which constitutes its own identity. The question now is; how do we get from such a process to an *agent* capable of transforming information into meaning? The first requirement is a self-generated system.

The existence of autonomous systems, is a consequence of embodied processes of recursive self-production which constitute structure and generates a distinct entity. Such systems, by virtue of their self-constituting nature and their subsequent intrinsic dependence on matter, individuate themselves from the environment they depend on. Such systems exists under "precarious conditions", because their existence will forever be under constant threat (Di Paolo 2009; Jonas 2001). We thus have the *first* requirement for agency, *a self-generated system,* and you'll note, the basis of strong embodiment.

But, this identity construction, also brings with it an *existential need to maintain structural cohesion* in the face of external threats, and is the source of the *asymmetry* between system and environment. To have a system-environment distinction of some kind, there needs to be *a system* to which we can attribute causal capacities, in relation to and as distinct from, its environment. This situation appears to deem *ontological priority* to the side of the system (Thompson 2007). The *system creates itself* as distinct from its environment and thereby is forced into an asymmetrical *dependence* with this same environment in order to maintain its identity (Hoffmeyer 1999).

However, this is merely an appearance. True enough, a system must create itself as distinct from its environment, and in this sense we can say that the system has an "ontological priority" (Moreno & Barandiaran, 2004). The system-environment interactions *necessarily* implies a pre-established system of some kind. Nonetheless, this does *not* mean that the system is *independent* or cut-off from its environment. Indeed, thermodynamic requirements means the system is open, dynamic, fluid and fully interwoven into its environment. Thus, rather than thinking of individual bounded units isolated from their environment, we have to think of these systems as *historically guided processes of contingently unfolding relationships* (Bateson 1979; Hoffmeyer 2008). That is, as a process of relationally co-constituted and coordinated embodied action, who's *being* is one of unfolding motion, embodying the system's past through the present towards the future.

The system, in creating its own identity, continuously defines itself *in relation to* its environment so that its identity is *constituted* by the web of *interactive relationships* it enters into, not by any of its intrinsic components nor its boundary. The system's past, present and future interactions, *defines* its identity. Therefore, the system *cannot* exist, cannot *be* what it *is*, without the environment and there is no environment without the system. Importantly, "asymmetry" should not be read as, a *privileging* of the system *over* the environment. All this implies is that, there needs to be a system of some kind first, which then can act in relation to the environment, but, *only in acting thusly* is there a system. Here again we see the double circular self-referential loop necessary for autonomous existence.

1.2 - Norms, Normative Function and Action

But how exactly are we to understand the *activities* of such systems? If the strong embodiment of autonomous systems grounds the ability to transform information into meaning, does this imply that bacteria, tics, frogs etc, are all *agents* capable of goal-directed *actions* and *cognition,* as the Uexküllian framework implied? The anthropogenic temptation will undoubtedly be to see nonhuman behaviour, as a hard-wired instinctual reflex to environmental stimuli, a mere "thrashing about" not worthy of the terms action or agency let alone cognition. As we saw, the inclination is to regard goal-directed actions as merely in the eye of the observer. Indeed, if we follow A&A's proposed MoC, this is the expected conclusion.

Certainly not just *any* mechanical movements or mere "thrashing about", can count *as* action. A ball rolling down a hill is not an agent, and even though "future-directed" we wouldn't want to say that it is a *goal-directed* action, nor would we call a Tourette's tick an action. Similarly, mechanical devices such thermostats appear to have goal-directed functions. Why are these "behaviours", which appear to be actively goal-directed, not actions? Frankfurt (1997) notes that: "the problem of action is to explicate the contrast between what an agent does and what merely happens to him, or between bodily movements that he makes and those that occur without his making them".

There are two connected strands to this articulation of the issue, one about *actions* the other about *agents*, taking them separately will be helpful. The first has to do with what distinguish any given *action* as such (as apposed to mere thrashing about), the second is, *what is an agent* such that we can say it *acts*. As we have seen, the traditional manner of accounting for this problem, also implicit in the above quote, is by taking adult humans as agents and introducing beliefs and desires cashed-out in terms of causally efficacious mental representations guiding action. As Hutto & Myin (2013, p. 14) point out, "any bout of activity counts as mindful *only* if it is connected with contentful states of mind". Naturally, only systems endowed with such states, are agents. But if we want to avoid cognitivism, these symbolic human-specific modes of thinking cannot be our *primary model* for *all* action.

The ideas developed over the last two chapters offers a more biologically inclusive and alternative means of grounding actions and agents. Recall that Uexküll argued that subjective agency acts as the *integrative mechanism* for generating coherent action. Implicit in this proposal is the idea that an agent's identity is given by its own functioning, by what it *does*. Using the ideas on autonomy proposed previously, we can understand action as the result of recursive self-maintenance, in relation to an environment. Ok, but why exactly should we regard these as *actions*? Because these observable activities are governed by *self-generated norms*.

How exactly do these norms come about? Autonomous systems develop and grow under intensely precarious conditions which are cause and effect of its worldly interactions. Thus a process, whether constructive or interactive, is functional if it *contributes to the global self-maintenance* of the system. These in turn become *normative*, by virtue of their integration into the overall dynamic organisation of the system, because constructive and interactive functional processes are ultimately responsible for the continued existence of the system itself (Christensen & Bickhard 2002). The system exists because of what it *does* and what it does needs to positively contribute to its existence.[20]

As the system is dependent on thermodynamic exchange with the environment, it will need to actively seek out food, shelter, warmth etc, if it doesn't it will lose its systemic cohesion and *disintegrate*. The system has no choice but to actively compensate for its inherently decaying organisation. It is precisely this precariousness which forms the basis of the normative character of the system's worldly activities. So, by norms we mean that dimension of behaviour where *value* comes into play, so that activities performed by a system are good or bad, adaptive or maladaptive, appropriate or inappropriate, functional and dysfunctional *for* the system itself (Ruiz-Mirazo & Moreno, 2000; 2004)

The system's self-constructed organisation imposes certain goals and norms and imbues these with *intrinsic teleology*. Internal dynamics and functionality are thus necessarily connected to the maintenance of systemic cohesion and on-going development. The system acts/functions out of sheer existential necessity and is the *active* source of its *own* goals, norms and functionality. Its own incessant need to maintain cohesiveness (identity), gives rise to intrinsic purposeful goal-directed action, to an *immanent purposiveness*. The system has an end (self-preservation) and is teleologically structured (strives-to-do-so). Such systems are endowed with *intrinsic normative functionality* (Bockhard 2009; Campbell 2010; Christensen & Hooker 2000; Christensen & Bickhard 2002; Collier 2002; Mossio et al. 2009; Saborido et al 2011).

[20] Here I won't make any distinctions between the terms, "action", "normative functionality", "goal" and "purpose" and will use them interchangeably. While the term ‘function’ is more commonly used with regards to a body part or organ and ‘goal’ or ‘purpose’ is better used when talking about whole organisms, all four terms nonetheless express the (common sense) fact that X does F in order to G. Thus, all these concepts contain a *teleological core*, intrinsic to all recursive self-maintaining systems. it's this core which will be emphasised here.

Therefore, as Richard Campbell (2010) notes, what distinguishes an action from mere bodily movements is that, bodily movements are *not* goal-directed because they do not "aim" at anything in particular. By contrast, actions *are* necessarily identified by their intrinsic ends, that towards which they do aim, they have a *teleos*. A Tourette's tick cannot be counted as action because it is not goal-directed or aimed at anything as such. While the "actions" of rolling balls and cybernetic mechanisms, are the products of *external* ascription and *not intrinsic* to the system itself. Moreover, these activities all lack a further fundamental feature of normative goal-directed action, the ability to *fail.*

Intrinsic normative functionality *implies* the ability to err, therefore, *only* systems possessing such functionality will be capable of making mistakes. This is because, as we just saw, when autonomous systems perform actions which are inappropriate in their environment, they are *inappropriate with reference to its own viability and structural integrity*. In other words, in accordance with i*ntrinsic self-generated norm*s, which can success or fail *for* the system itself. Norms are thus closely connected to the organisation of the system itself and what is or is not conducive to its *own* ongoing operations.

To illustrate these point, consider Jonas's (2001) criticism against cybernetic teleology. Jonas's criticisms centres around the observation that a feedback loop, or any other regulatory mechanism (think of the thermostat again or Jigro), might provide a means to achieve a purpose but it will never *originate* the purpose itself (Franchi 2010). As he points out, teleonomical machines merely accomplish the purpose of their users, not their own and as such they cannot make mistakes. Jigro does not fail when he cannot complete the jigsaw, nor does a thermostat err when it does not increase the heating. Cybernetic teleonomy conflates the basic difference between the existence of a purpose with its realisation. The same point equally applies to the EMH's notion of "coupled system".

This explains why sensorimotor loops (or abstract functional organisation generally) are not *sufficient* for goal-directed actions, and indeed what is missing: *autonomous agency*. But, why is this important, why can we not proceed simply by accepting teleonomic agency? The simple reason is that, teleonomic systems are *not* agents and for this reason, not capable of genuine action or cognition. They are only weakly embedded dyadic reactive systems unable to act on their own behalf.

This ability to err, involves what Campbell (2011, chap. 4) calls, a capacity for "error-detection". The system needs to be capable of differentiating between actions that *succeed* and actions that *fail*. Let us illustrate the central idea further with an example of an autonomous system, a frog.

A frog's capacity for making mistakes lies in its ability to recursively and differentially respond to future situations. It cannot be “wrong” *unless* it is capable of adaptively adjusting its behaviour and learn, as best as it can, to control its circumstances. In order to learn, however, it must have available alternate potential actions, and the ability to select among them. Without this capability there can be no sense of “choosing” appropriate (behaviour that supports viability) or inappropriate (behaviour which given the circumstances failed) behaviours for particular environmental conditions. Thus, when a frog flicks out its tongue in response to a moving pebble, its actions have *failed*.

We are justified in calling the frog's behaviour a mistake, because its action can be “discovered to be wrong” by the *frog itself*. Campbell (ibid, pp. 78-86) points out that in these situations the discovery might come in the form of a "surprise" or "discomfort". Surprise because it contradicts the frog's own expectations, expectations which stem from its need to be able to anticipate future conditions in relation to current environmental conditions. To be surprised then, is to have anticipated, or extrapolated incorrectly; for the near-future to fail to align with the anticipation. What makes an action normativily “wrong”, rather than merely a mechanical error, is that there is systemic malfunction related to the frog's internal autonomous dynamics. The frog has an *intrinsic functional need* that is left unfulfilled by some subprocess specifically taken by the frog to fulfil that function.

Essentially the frog flicks its tongue toward the self-maintaining function of sustenance, for the purpose of eating and becoming nourished, which allows it to continue to carry out processes which contribute to its overall viability. However, if it consumes a pebble, the function of flicking toward sustenance has failed, because it does not nourish the frog. The broader process of system self-maintenance is frustrated. The system has failed in its self-maintaining processes (Campbell ibid, p. 80). For these reasons, the frog can be said to perform a *genuine action*; it is grounded on an intrinsic norm, it is goal-direct (it has a teleos) and is thus capable of failure.

Note that goal-directed actions also implies *deep integration* as Uexküll advocated. From the autonomous perspective, actions can only be understood as the function of *whole* integrated systems, in relation to an environment and *not* of any of its subcomponents. It is the *entire* frog that is goal-directed, that acts, not any of its components. Indeed, only the *activities* (flicking out a tongue) themselves can be coherently regarded as succeeding or falling, not any of the various subcomponents involved in the process (Campbell, 2009; Hutto, 2011a,b). Therefore, it is *incorrect* to attempt to reduce actions to a particular subcomponent, including mental states.

In sum, recursive self-maintenance is a process driven by the self-generated purpose of maintaining identity, and is ultimately, an act of self-affirmation and self-reference with far reaching consequences. Goal-directed actions emerge from self-generated norms, have a teleos and are always, processes of self-reference. This provides a way out of an observer dependant semantic ascription/teleonomy of the processes involved, because the failure to perform certain goal-directed actions conditions the very existence of the system itself. Finally, it also meets requirements two and three for agency; recursive self-maintaining systems perform *actions* in accordance with *self-generated norms.* Therefore, *genuine goal-directed action,* need not only be the product of humans beings nor involve mental states.

The last point is worth reemphasising: *nothing* like symbolic thought is required or involved in these processes. Normative functionality need not be conceptual, though naturally it can be conceptualised. Even though norms govern the interaction of the system, they are not necessarily explicit for the system itself. At a primordial level, many norms are implicit and not immediately capable of being explicitly identify by the system, though naturally for some systems they can be. So, it matters for the frog that it finds the appropriate nourishment and does not go hungry or whether its environment is hospitable or hostile. To remain viable a system will have to take relevant action and there is no reason to think this involves anything like concepts.

2 Agency to Bio-semiosis

2.1 - Normative Function and Signs

We began by stipulating that basic agency required *four* minimal condition; one fundamental piece remains missing for full blown agency *and* cognition. In the remaining subsections, I will argue that intrinsic normative functionality, needs to be understood as *natural semiosis*. Embodied self-constitution leads to intrinsic normativity which leads to *meaning, signification and value,* which needs to be understood in terms of *sign-function*. Values *for* a system, emerge with normative functionality in relation to the functional importance of particular signs for viability (Emmeche 2002).

As Hoffmeyer (2008a, p. 65) states; "In the biological world, certainly, signs incite the generation of interpretants in the form of actions which are future-oriented, inasmuch as living beings always seek signs for survival and for reproduction". Sign-function is then a fundamental part of the immanent purposiveness of autonomous systems. To fully understand agency, the capacity to navigate the environments *courtesy of signs*, cannot be ignored.

In Chapter 4 the Umwelt was characterised as a *relational domain*, a circular organisation constituted by functional cycles. We briefly indicated that this model provided the three basic ingredients for semiosis; *object, interpreter and sign,* With an enriched understanding of *embodied agency* (the interpreter), I now want to argue that this relational domain, the domain where information gets transformed into meaning, is fundamentally; *a cognitive domain mediated by signs*. Echoing Pattee (2005, p.299), I suggest that, minimal cognitive systems can be distinguished from the non-cognitive by their intrinsic ability to use and *dependence* on, signs. A basic MoC is thus identified with the capacity to read signs.

With this in mind, what I previously termed the "ability to transform information into meaning", will be recast as the ability to *read natural signs*.[21] Drawing inspiration from the field of *biosemiotics*, I shall call recursively self-maintaining systems, which meet all four requirements for agency and cognition; *bio-semiotic agents*. This is to emphasises that such systems are; *agents*, *traffic in signs and bear a MoC*. Biosemiotics will provides us with a unifying conceptual framework for articulating this claim and bring the various strands together so as to conclude this work.

2.2 - Biosemiotics

Biosemiotics[22] is an emerging field of research, which rejects the passive nature of current formal information-based approaches to the explanation of life and cognition. It is primarily concerned with problems of *meaning* and *semiosis* from a biological and evolutionary perspective and how these emerge through *active semiotic interactions.* It emphasises *action* in the origin of *signs* and investigates the roots of "language" in nature, highlighting the active role of the organisms which *use* these signs.

A central thesis of biosemiotics, derived from Uexküll, is the idea that *all* living organisms engage in processes of semiosis (meaning-making)[23] and communication by means of signs. It studies how signs are used, produced, exchanged and come to have *signification* across the biological spectrum, both between and within living system. It studies a range of diverse phenomena, from animal language through to molecular genetics (Barbieri 2003; 2007; Brier 2008a,b; Deacon 2012; Emmeche 2001;. Favareau 2010; Hoffmeyer 1996; 2008a, 2008b; Kull 1998; Sebeok 2001; Wheeler 2006). Thus;

> Biosemiotics can be defined as the science of signs in living systems. A principal and distinctive characteristic of semiotic biology lays in the understanding that in living, entities do not interact like mechanical bodies, but rather as messages, the

[21] The two ideas are pretty much the same thing, only now, I have more conceptual resources to refine the notion of transforming information into meaning.

[22] Unlike the majority of biosemioticians, I will not consider semiotics on microscopic levels such as signalling between cells or organs, but only ecological semiotics as the study of semiosis in agent-environment systems. Thus for the purpose of this work, I will follow Morris (1946) more narrow definition of semiosis as "a sign-process, that is, a process in which something is a sign to *some organism*". As a consequence I do not address issues to do with the "semiotic threshold" (Eco 1976). That is, on the scope of applicability of semiotics, on the placement of the lower semiotic threshold.

[23] In this work I use "meaning-making" and "semiosis" interchangeably.

> pieces of text. This means that the whole determinism is of another type (Kull 1999, p. 386).

Therefore, all living systems (not just human brings) are not mere brute mechanical dyadic (cause-and-effect) processes, but rather, *semiotic agents* involved in *triadic* (*agent*-sign-object) interpretive meaning-making processes.

Contrary to anthropogenic intuitions, organisms whose behaviour do not unequivocally involve human-style-reasoning cannot automatically remain outside the cognitive domain. Nor can we consistently regard the behaviour of these organisms as, teleonomic and predominantly composed of deterministic dyadic, inflexible, hard-wired reactions to environmental stimuli (Dennett, 1984; Gould & Gould, 1998; Sterelny, 2001). From the biosemiotic perspective the biological world is best understood not solely in terms of its physical and chemical properties, but also as a world made up of biological signs and meanings with *living systems as agents in their own right.*[24]

Semiotics deriving from Saussure has concentrated on cultural signs especially language. Here the focus is on what a sign might be and on the essential *arbitrary* relationship between a sign and that which it denotes. By contrast, biosemiotics mostly draws from the work of C. S. Peirce, which is seen to offer a broader conception of signs and semiosis. In particular, meaning and signification is dealt with on the basis of a flow of *embodied action.* This action is genuinely open and creative, making biosemiotics a natural framework on which to frame biological cognition (cf Favareau 2006).

The core concept for biosemiotics is the *sign*, so we need to understand how this concept is used.[25] Perhaps the most important thing we need to know about signs is that there are no such independently existing entities as "signs" as such, rather, there are only; "independently existing entities that are *used as signs by the agents that act upon*

[24] Biosemiotics does not provide an account of agency as such, and it was for this reason we had to introduce autonomy as a complementary means.

[25] Note that signs are not symbols, though they could be. Peirce identifies three types of sings; *icons*, *indexes* and *symbols*. Indexes signify by having a direct connection to what they signify, icons signify by resemblance, and symbols signifies by conventional association (Peirce 1955). Most living organisms only use indexes while human arguably are the only creature which can use symbols.

them as such" (Favareau 2007, p. 69). Thus the notion of a sign, cannot be understood apart from the broader concept of *semiosis*, whereby, $\mathscr{A}$ interprets $\mathscr{B}$ as "standing-for" $\mathscr{C}$. Thus understood, signs *emerge* through creative *processes of semiosis,* which; "is the sign process — the fundamental process that carries meaning and in which meaning is created" (Kull et al, 2011). Semiosis is then a *relational triadic* process whereby something comes to stand for something ells to someone or something. Importantly, signs are rooted both in the world *and* the agent, but not reduced to either.

For example, footprints on the snow (sign vehicle) stands for something (the object), that a person has walked by. Now, this can only function *as a sign* insofar as it is *interpreted* by a system (what Peirce calls the interpretant). Without an interpretation, a footprint is a mere mark. Only when *interpreted* does it function *as* a sign and only through semiosis does the sign relation come into being. In other words, the sign-function has to be, implicitly or explicitly, recognised by some system, which in some sense instantiates the sign-function. As understood in biosemiotics, signs are the natural constructions of biological organisms in the active pursuit of their own goals. Because these are *irreducibly* relational triadic processes, they *cannot* be something which we can point at with the index finger, or reduced/identify with some objective thing or physical entity in the world even though they are rooted in the world (Deely 1990).

Biosemiotics follows Peirce in recognising that semiosis involved *three* interconnected elements rather than two. Historically, sign relations had been conceived as a dyadic relationship between a signifier (that which stands for something ells) and a signified (the something ells). Such a dyadic view remains influential both in analytic philosophy in the form of the correspondence theory of truth, and as we seen, in cognitive science in the form of the traditional information-processing models. But through the lenses of biosemiotics, semiosis is understood as triadic processes whereby aspects of the environment are taken as signs which are meaningful and significant *for* the organism and serve to guide behaviour.

Given the triadic *process* (as apposed to static) *nature* of signs, their causality differs from the brute linear mechanistic (dyadic) causality of forces. While signs can be ignored or misinterpreted forces exert causal power with mechanistic efficiency (Hoffmeyer 2008a). Triadic sign process are perfectly physical causal processes, the difference is that they are nonlinear, dynamic, inherently agent-relative and context-dependent. They do not depend on energy or mechanical force but on a flow of *information as signs*. Thus, signs are meaningful not because they act on agents causally, as an external force, *but because they are taken by a particular system to mean something*. But is it not only human beings, with highly evolved linguistic systems, which use signs and partake in semiosis?

For much of history it has been taken as a given that man is the *only* semiotic being, the only creature capable of appropriately reading signs. Although semiotic processes are ubiquitous in the biological world, these are not acknowledged as such, but conceived in terms of meaningless mechanical forces/interactions of material substrates. The work discussed in the previous chapters already cast some doubts on this conviction. We can now appreciate that, even the "simplest" of living organisms, do in actual fact successfully use signs to guide their behaviour, rather than react mechanically. Ultimately, all organisms are agents who *actively interpret* and are guided by, meaningful signs in their surroundings.

Essentially, biosemiotics follow Peirce in suggesting that the universe is perfused with signs which are *not all exclusively a product of human minds* but naturally occurring processes throughout nature. Thus, the biosemiotic conception of signs and sign-function, is committed to a universe populated by dynamical systems, actively taking part or engaged in, making sense of their surroundings via signs (Favareau 2006; 2007; 2010; Hoffmeyer 2008a).

2.3 - Bio-semiosis as Cognition

We now have all the four required pieces of the puzzle which finally puts us in a position to complete our picture of cognitive agency and present a location-neutral non-species-specific, non-cognitivist MoC.

Any system which: "finds itself produced by itself is ipso facto a locus of sensation and agency, a living impulse always already in relation with its world" (Weber & Varela, 2002, p. 117). Bio-semiotic agents are such systems; they create their own identities and have full responsibility for coupling with the environment. In so doing, a *relational cognitive domain* constituted by *sign relation* - the *Umwelt* - emerges. This domain is not pre-given in advance or independently of the system, but rather co-evolves and is co-determined (is brought into being) by the system through functional cycles which variously modulates its unfolding behaviour over time. These functional cycles are not a mechanical dyadic (stimulus-response) coupling, but rather, historically unfolding, creatively open-ended*, interpretive processes*. They are *interactive semiotic loops*. whereby meaning and significations emerge through embodied interpretation. All systems which read, interpret and understand meaningful signs, I argue, bare a basic MoC. Note that this MoC is non-species-specific, non-cognitivist, and location-neutral.

Connecting these ideas to normative functionality, we can now see that the capacity to maintain systemic cohesiveness, is semiotic and intimately dependent upon an *ability to read and correctly interpret meaningful signs*. Because the system has an intrinsic concern for its own existence, it is forced to act, but it only acts *if* it can create meaning as a means of coping and making a living in its semiotic world. So emerges an Umwelt replete with meaningful natural signs, precisely at the junction where "insides" and "outsides" collide. Signs are thus fundamental for goal-directed action as they serve to guide system's worldly activities.

Therefore, from the most basic to the most complex, all bio-semiotic agents regulate their functional cycles in such a way that a neutral world is transformed into a domain perfused with signification and meaningful signs. What is "good" or "bad", "right" or "wrong" is defined by the system itself in triadic meaning-making processes, and not determined by brute mechanical force nor simply the ascription of an external observer (Hoffmeyer 1996; 2008a; Weber 2001a,b; 2002). Nor is the ability to read and interpret worldly signs the exclusive privileged of sophisticated linguistic-based human activities, involving reasoning and inference. Rather, it is a natural embodied biological phenomena, varying in complexity and evident across the biological domain.

It was for these reasons that we had to introduce an embodied and contextual, conception of information and which can now be recast as signs in semiosis by the living. From this perspective, signs do not exist "out there" in the world independent of bio-semiotic systems, ready-made and awaiting to be "picked-up", nor are they in the head, rather, these require an *agent* and emerge through interpretative triadic semiotic processes. Signs *are* the difference that make a difference *for* a system. Information is not observer-independent raw material but needs to be understood in the context of meaning and signs (Brier 2008a).

Bio-semiotic agents are thus enmeshed in a world of signs, a world which they are required to read and interpret in meaningful life supporting ways. The word "read" here is only partially metaphorical. As highlighted by Sheets-Johnstone (2009), the etymology of *read* contains both the sense of "to discern" and "to discover the meaning or *significance* of something". To which we can also add the sense of "to interpret". If we follow this original meaning, reading need not be tied to human-specific symbol use, nor regarded as a misleading metaphor. Adopting a "primordial" sense of the term, to read or interpret, can be understood as being deeply connected to the embodied non-linguistic non-symbolic (know-how) activities of bio-semiotic agents in relation to what is significant for self-preservation. Here meaning and *doing* become fundamentally inseparable and the meaning derived from these doings are not conceptual. Meaning as signification occupies a continuum across a broad array of animate life. Bio-semiotic agents *live* in a world that is already meaningful, but not necessarily because it requires explicit, symbolic, or representational modes of thought.

Equally, "interpretation" is not used here in a metaphorical sense, but a literal one. It might be objected that only language using organisms can be interpreters. This is however an unsubstantiated anthropogenic bias response. The work of Uexküll and biosemiotics coupled with the autonomy perspective, provides us with the right sorts of tools for understanding why other living organisms also need to be understood as *natural interpreters*. The Umwelt is *constituted* by acts of selection, identification and appropriation by the organism. Acts which undeniably have central characteristics of interpretation. Any system capable of selectively discriminating salient aspects of its environment and selectively responding is engaged in interpretive semiosis.

Thus. at the most primordial embodied level, interpretation simply requires the ability to recognise something *as* something else. What an organism perceives, the particular objects in its Umwelt, are never perceived as neutral objects, they are *meaningfully perceived as* food, or *as* shelter or *as* something-to-climb-up. If we can agree that bio-semiotic agents use signs, then it seems to directly follow that the very process of sign use, is *intrinsically* an interpretive act.

Consider a bacterium, for whom both sugar and saccharine function as signs, but only sugar is correctly interpreted as being nourishing. Nonetheless *both* function as meaningful signs for the bacterium and guide its behaviour even though one is a misinterpretation (Markoš & Cvrčková, 2002). At this primordial biological level, interpretation is simply "hermeneutics by the living" (Markoš 2002), an embodied ability which life forms, as agents in their own right, have for *making sense of their world.*

Through evolved mechanisms, manifested through normative functionality, system can interpret/misinterpret their world, not merely mechanically react. For such systems, as we have seen, success or failure is not something ascribe from the outside by an observer but intrinsic to the agent itself. Thus, due to this intrinsic normative functionality, the saccharine gradient does not *cause* the system to misinterpret that particular sign, but rather, *interpretation being intrinsically normative*, is by its very nature inherently prone to error.

Interpretation and normative functionality can now be seen to be two sides of the same coin, with interpretation placing the *subjective agency* of the system at the forefront. Thus understood, an Umwelt can only emerge if the system does some interpretative work. The system needs to be not only semiotically sensitive to relevant signs, but also, the active *creator* of meaning, in the sense of having to actively interpret (Hoffmeyer 2007; Markoš et al. 2009; Stjernfelt 2007). Interpretation is thus an *active open-ended creative process* which always refers back to the self-maintenance of the system. A self-referential process embodying the system's past through the present always guiding it towards the future.

Consider the frog again. Let me conclude by suggesting that rather than claiming that the frog *misrepresents* flies (cf. Millikan 1984) when it catches a pebble, it is more accurate to say that it *misinterprets* them.

What exactly *is* the difference? Misrepresenting is a property *ascribed* to the frog from the outside by some observer. A property which can be ascribed because the observer has access to two separate domains; the frogs behaviour *and* the frog's direct environment. A connection is drawn between the two and it is then inferred that it has misrepresented the environment in some crucial respects. But not for the frog! From the *perspective of the frog*, there are *no* representation and thus no misrepresentation. The frog reads a sign, because it is significant and imbued with meaning, *but,* which does not contribute to its own self-maintenance, it thus has *misinterpreted* the sign. It is a misinterpretation, rather than a misrepresentation, because it is *intrinsically related* to its current state and overall identity, and as a consequence it cannot fail to have intrinsic meaning for the frog itself. Thus the meaning of this sign is an action or response not a representation in the system.

Therefore, the potential to be mistaken, to *misinterpret* signs, is an *essential requirement* for any purposeful behaviour and consequently full-blown bio-semiotic agency. This process is not instructed from the outside and intrinsically open to failure. The frog can only misinterpret the pebble *if* it functions *as a sign* which *can be* interpreted. And if it can be interpreted it can be *mis*interpreted. Importantly however, this is still a purposeful meaningful action *even though* it is mistaken, which interpretation it makes has significance for its viability. This is more inline with our Uexküllian framework, which is more appreciative of the fact that the frog is a agent in its own right.

Ultimately, signs, cognition, and interpretation are tightly interconnected. All bio-semiotic agents have the ability to recognise signs, indeed cannot survive without them, and as such live in an inherently meaningful world and this is, I would argue, the essence of bio-semiotic cognition.

Conclusion

In this chapter we have argued that there are four minimal requirements for a system to be considered an agent and minimally cognitive. We argued that strongly embedded/ embodied systems meet all four requirements and thus serve as the basis of a MoC.

Conclusion
From Extended Minds to Bio-Semiotic Agents

1 The Extended Mind is Dead, Long Live the Extended Mind?

In this dissertation, as an effort to develop a non-cognitivist non species-specific location-neutral MoC, we presented a *sketch* of a framework which placed the notion of cognition at the centre of the biological domain. Drawing from biosemiotics and Uexküll, we argued that living systems are, not only deeply interwoven into the fabric of the world, but also bio-semiotic *agents* in their own right, who interpret signs for their own self-generated ends.

We replaced an anthropogenic, individualist, information-processing approach, with triadic natural semiosis, stemming from the intrinsic autonomous dynamics of self-maintaining systems. Cognitive processes were reconceived in terms of complex relational interactions - functional cycles - of bodies intertwined within local environments through feedback, circular causality and signs. Cognition *emerged* from these irreducible interactive interpretative processes. Ultimately; "there may be no meaning without cognition, and no cognition without meaning" (Sonesson 2009, p. 43).

We proposed that *interpretation* provided organisms with the meaningful information required to survive. Bio-semiotic agents stay alive by adaptively interpreting and understanding the environment and taking into account the dangers and benefits of various kinds of external events and objects. For this reason, we argued that we need to understand *all* meaning-making process as cognitive, involving some degree of knowledge and understanding. Certainly not in the conscious human manner, but on the grounds that the organism *knows-how to read the signs* so as to make a living in the world.

Because we did not posit internal mental representations connecting agents to the world, the distinction between cognitive processes and mental states, does not apply. All higher forms of cognition, including linguistic and symbolic modes of cognition, emerge from these meaning-making processes (Hoffmeyer 2012).

All higher-level abilities require and depend on, a complex range of non-conceptual embodied skills, an embodied sign-mediated intentionality (Hoffmeyer & Kull 2003). These sign-mediated embodied skills deserve to be considered *cognitive* in their own right. For the tic, as for a human being, to know, is to know what to do right now, at this very moment in this very context, in order to continue living. Through evolution, most of this knowing common to all life forms, has been sedimented into living bodies and Umwelten, thereby relinquishing the need for it to be solely the work of complex highly evolved brains. Yet, this knowledge, forms the *bedrock* for symbolic/linguistic modes of cognition. Complex human cognition, rests upon a basic cognitive bedrock that needs to be understood as non-representationalist, triadic sign-mediate processes first. From this perspective, we *cannot* separate the cognitive world into two neat domains, as the distinction is solely of our own making.

Contrary to the EMH, cognition is not primarily human centred and spatially located but biological and relational. It begins from the bottom-up with *whole biological agents* living in the world, there is no "gap" requiring filling. Cognition emerges from the self-organising bio*semiosis* of organisms in extended dynamic interactions. Consequently, *cognition cannot fail to be constitutively embodied and world-involving.*

While the underlying mechanisms causally enabling cognition are naturally essential, it is the *interaction* among these and *not the mechanisms in themselves*, that give rise to cognition. While this may suggest that cognition is "extended", this is at best a misleading metaphor. Even if some components are located externally to the agent, this does not therefore make cognition extended, nor "in the head" for that matter. Rather, only the *interactions between* the various components give rise to cognition. As we identified cognition with triadic semiotic processes, cognition cannot be identified with the components of its constituting mechanism, be they internal or external. Cognition is a relational process with no distinct location.

Thus, questions of whether cognition is spatially located ‘inside’ or ‘outside’ a bio-semiotic system, are rendered completely meaningless from this perspective. Evidently, there are continuous dynamic semiotic loops, but cleanly no determinate location.

2 Looking Ahead

The approach developed here has much in common with, and is greatly inspired by, enactivism (cf. Froese & Di Paolo 2011; Hutto & Myin 2013; Thompson 2007; Varela et al 1991). Particularly autopietic enactivism and radical enactivism as defended by Daniel Hutto. As autopietic enactivism draws heavily from phenomenology it places it in the anthropogenic framework, *even though,* it is at the same time committed to life-mind continuity. Primarily for this reason, I did not use the standard enactivism terminology and opted for the Uexküllian biosemiotics framework. Moreover, I think central phenomena expressed by enactivism, such as sense-making, is inherently semiotic. While biosemiotics could also benefit from enactivism, particularly regarding the notion of mental representations, which remains highly ambiguous and in need of clarification.

Given that biosemiotics has not been much discussed in cognitive science, nor enactivism much discussed within biosemiotics, potential theoretical benefits may be gained by considering the two together and exploring how they could mutually compliment each other. This is my intended next step as research for a PHD thesis.

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